

B.SC. Semester – 5

Major Mathematics Subjects

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester V (Mathematics)
BS23MJ5MT1 Major-1: Analysis-II (Theory with IKS)

Hours: 4 /week

Credits: 4

Unit I:

Madhava of Sangamagrama: Madhava Series, value of π and other contributions.

Definition of metric space, examples, interior point, open set, limit point, closed set, closure of a set, Compact sets and Connected sets.

Unit II:

Aryabhata: Place value system, approximation of π and other contributions.

Sequences and Cauchy Sequences, Convergence of sequences, complete metric space, Limits of functions, Continuous functions, Continuity and compactness, Continuity and connectedness.

Unit III:

Bhaskara-I: Representation of numbers and other contributions.

The Riemann-Stieltjes Integral: Definition, properties, Refinement of partitions, Change of variables, Integration and differentiation, Fundamental theorem of calculus and Integration by parts.

Unit IV:

Bhaskara-II: Lilavati, Bijganit and other contributions.

First and Second Mean-Value theorems, Rectifiable curves, Sequences and series of functions: Pointwise Convergence, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Differentiation.

Reference Books:

1. Mathematical Analysis, Tom M. Apostol, Narosa Publishing House, 1985.
2. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition.
3. Principles of Mathematical Analysis, Walter Rudin, Mc Graw Hill book Co.
4. Mathematical Analysis - S. C. Malik, Savita Arora, New age international publishers.

References (For IKS part):

1. History of Hindu Mathematics, B. Datta and A. N. Singh, Bombay: Asia Publishing House, 1961
2. A history of mathematics, Victor Katz., 3rd ed, Pearson Education (Chapter 8)
3. Wikipedia articles

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester V (Mathematics)

BS23MJ5MT2

Major-2: Differential equations and Geometry (Theory)

Hours: 4 /week

Credits: 4

Unit I:

Definition of differential equation, order and degree of differential equation, types of first-order and first-degree differential equations: separable variable, homogeneous differential equation, non-homogeneous differential equation, exact differential equation, necessary and sufficient condition of exact differential equation, linear differential equation and Bernoulli's differential equation, Linear differential equation first order and higher degree with application.

Unit II:

Method of solving differential equations of first order and higher degree: solvable for y , solvable for x , solvable for p (where $p = \frac{dy}{dx}$), Clairaut's differential equation and Lagrange's Differential Equation. Linear differential equations of higher order and degree one with constant and variable coefficients: Complementary Function and Particular Integrals, Inverse operator and methods of finding particular integral (Integral corresponds to terms of the form e^{ax} , x^m , $\sin ax$, $\cos ax$, $e^{ax}V(x)$ and $xV(x)$).

Unit III:

Definition of a sphere, Cartesian equation of a sphere, General equation of a sphere, Equation of a sphere with diametrically opposite end points, Equation of a sphere through a given circle, Intersection of a sphere with Line, Intersection of a sphere with plane, Intersection of a sphere with sphere (No theory but only problems), Equation of a tangent and normal plane to a sphere, and Orthogonal spheres.

Unit IV:

Definition of cone, Homogeneous equation of cone, right circular cone, Equation of envelope of cone, Problems on cone, Definition of cylinder, Homogeneous equation of cylinder, right circular cylinder, Equation of envelope of cylinder and Problems on cylinder.

Reference Books:

1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
4. Introductory course in Differential equations - Murray, Ulan Press.
5. Analytical solid geometry - Shanti Narayan, S.Chand & Company.
6. Co-ordinate Geometry By: R.J.T. Bell.
7. Solid Geometry(three dimension) - H. K. Das, S. C. Saxena and Raisinghania, S. Chand.
8. Coordinate Geometry of Two and Three Dimension, P. Balasubramanyam, et. al. , Tata Mc Graw Hill Publ. Co., 1994.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester V (Mathematics)

BS23MJ5MT3 Major-3: Analysis-II and Differential equations and Geometry (Practical)

Hours: 8 /week

Credits: 4

List of Practicals:

1. Examples on metric space, interior point, open set, limit point, closed set and closure of a set.
2. Examples on Compact sets and Connected sets.
3. Examples on Sequences and Cauchy Sequences, Convergence of sequences, complete metric space and Limits of functions.
4. Examples on Continuous functions, Continuity and compactness, Continuity and connectedness.
5. Examples on The Riemann-Stieltjes Integral: Definition, properties and Refinement of partitions.
6. Examples on Integration and differentiation, Fundamental theorem of calculus and Integration by parts.
7. Examples on First and Second Mean-Value theorems, and Rectifiable curves.
8. Examples on Pointwise Convergence, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Differentiation.
9. Problems on finding the order and degree of the differential equations, Exact differential equations and Integrating factors.
10. Problems on Linear differential equations, Bernoulli's differential equations, Clairaut's and Lagrange's differential equations.
11. Problems on Method of solving differential equations of first order and higher degree: solvable for x , y and p (where $p = \frac{dy}{dx}$).
12. Examples on finding the Particular integral terms of the form e^{ax} , x^m , $\sin ax$, $\cos ax$, $e^{ax}V(x)$, $xV(x)$.
13. Problems on Sphere-I (Cartesian equation and General equation, Equation of a sphere with diametrically opposite end points, Equation of a sphere through a given circle and Intersection of a sphere with Line).
14. Problems on Sphere-II (Equation of a tangent and normal plane to a sphere, and Orthogonal spheres).
15. Problems on cone.
16. Problems on Cylinder.

Reference Books:

1. Mathematical Analysis, Tom M. Apostol, Narosa Publishing House, 1985.
2. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition.
3. Principles of Mathematical Analysis, Walter Rudin, Mc Graw Hill book Co.
4. Mathematical Analysis - S. C. Malik, Savita Arora, New age international publishers.
5. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
6. Elementary Differential equations-Kella, Mcgraw-Hill.
7. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
8. Introductory course in Differential equations - Murray, Ulan Press.
9. Analytical solid geometry - Shanti Narayan, S.Chand & Company.
10. Co-ordinate Geometry By: R.J.T. Bell.
11. Solid Geometry(three dimension) - H. K. Das, S. C. Saxena and Raisinghania, S. Chand.
12. Coordinate Geometry of Two and Three Dimension, P. Balasubramanyam, et. al. , Tata Mc Graw Hill Publ. Co., 1994.

B.SC. Semester – 5
Minor Mathematics Subjects

SHRI GOVIND GURU UNIVERSITY
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester V (Mathematics)

BS23MN5MT1 Minor : Introduction to Differential Equations and Real Analysis (Theory)
Hours: 4 /week Credits: 4

Unit I:

Definition of differential equation, order and degree of differential equation, types of first-order and first-degree differential equations: separable variable, homogeneous differential equation, non-homogeneous differential equation, exact differential equation, necessary and sufficient condition of exact differential equation, linear differential equation and Bernoulli's differential equation, Linear differential equation first order and higher degree with application.

Unit II:

Method of solving differential equations of first order and higher degree: solvable for y , solvable for x , solvable for p (where $p = \frac{dy}{dx}$), Clairaut's differential equation and Lagrange's Differential Equation. Linear differential equations of higher order and degree one with constant and variable coefficients: Complementary Function and Particular Integrals, Inverse operator, and methods of finding particular integral (Integral corresponds to terms of the form e^{ax} , x^m , $\sin ax$, $\cos ax$, $e^{ax}V$ and xV).

Unit III: Real Numbers

Algebraic properties of real numbers, Order structure of real numbers, Intervals, Bounded and unbounded Sets, Supremum and infimum, Non-Completeness of $\mathbb{Q}$ and Archimedean property of real numbers.

Unit IV: Real Sequences and Series

Sequences, Bounded and unbounded Sequences, Limit point of a sequence, Convergent sequences, Convergence of monotonic real sequences, Cauchy sequences, Cauchy criterion for convergence of real sequences, Convergence and divergence of an infinite series, Necessary condition for convergence and Cauchy criterion for convergence of series.

Reference Books:

1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
4. Introductory course in Differential equations - Murray, Ulan Press.
5. Mathematical Analysis (5th Edition) - S. C. Malik, Savita Arora, New age international publishers.
6. Elements of Real Analysis - Charles G. Denlinger, Jones and Bartlett publishers.
7. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition.

BS23MN5MT2 Minor: Introduction to Differential Equations and Real Analysis (Practical)
Hours: 8 /week **Credits: 4**

Number of Practicals: 16

1. Examples of separable variable, homogeneous differential equation and non-homogeneous differential equation.
2. Example of exact differential equation.
3. Example of linear differential equation and Bernoulli's differential equation.
4. Example of Linear differential equation first order and higher degree.
5. Example of Clairaut's and Lagrange's differential equations.
6. Example of Linear differential equations of higher order and degree one with constant and variable coefficients: Complementary Function and Particular Integrals.
7. Example of Inverse operator.
8. Example of Bounded and unbounded sets.
9. Example of Supremum and infimum.
10. Example of Non-Completeness of $\mathbb{Q}$.
11. Example of Archimedean property of real numbers.
12. Example of Bounded and unbounded Sequences.
13. Example of Convergent sequences and Convergence of monotonic real sequences.
14. Example of Cauchy sequences and Cauchy criterion for convergence of real sequences.
15. Example of Convergence and divergence of an infinite series.
16. Example of Necessary condition for convergence and Cauchy criterion for convergence of series.

Reference Books:

1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
4. Introductory course in Differential equations - Murray, Ulan Press.
5. Mathematical Analysis (5th Edition) - S. C. Malik, Savita Arora, New age international publishers.
6. Elements of Real Analysis - Charles G. Denlinger, Jones and Bartlett publishers.
7. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester V (Mathematics)

BSC23SE506 Skill Enhancement Course: Number Theory

Hours: 2 /week

Credits: 2

Unit I:

The division algorithm, divisibility and the greatest common divisor. Euclid's lemma; The Euclidean algorithm, Linear Diophantine equations; The Fundamental theorem of Arithmetic, Congruence relation and its basic properties, Linear congruences and the Chinese remainder theorem.

Unit II:

System of linear congruences in two variables; Fermat's little theorem and its generalization, Wilson's theorem and its converse, The Sum and Number of Divisors, The Möbius Inversion Formula, The greatest integer function, Euler's Phi-function and its properties.

Reference Books:

1. Elementary Number Theory (7th ed.), Burton, David M. (2011), McGraw-Hill Education Pvt. Ltd. Indian Reprint 2017.
2. Number Theory - S. G. Telang, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
3. Elementary Number Theory with Applications, Thomas Koshy, Academic Press, 2007.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester VI (Mathematics)
BS23MJ6MT1 Major-1: Graph Theory (Theory with IKS)

Hours: 4 /week

Credits: 4

Unit I:

Narayana Pandita: Ganita Kaumudi and other contributions.

Definition and basic properties, matrix representation of a graph, subgraph, isomorphism of graphs, walks, paths and circuits Connected Graph and components, Euler graph, Hamiltonian path and circuits.

Unit II:

Srinivasa Ramanujan: Number theory and other contributions.

Tree definition and basic properties, Bridges, Rooted and Binary tree, Spanning tree, Fundamental circuits, Connector problems: Kruskal's algorithm and Prim's algorithm.

Unit III:

Prasanta Chandra Mahalanobis: Mahalanobis distance and other contributions.

Shortest path problem: Dijkstra's algorithm , Cut sets, definition and properties, all cut sets in a graph, Connected graphs, Cut vertices and connectivity.

Unit IV:

Harish-Chandra: Representation theory and other contributions.

Planar graphs, Kuratowski's graphs, Euler's formula, Dual of a plane graph, Graph coloring and Applications of graph coloring.

Reference Books:

1. Discrete Mathematics with Graph Theory (3rd ed) - Edgar G. Goodaire and Michael M. Parmenter (2011). Pearson Education Pvt. Ltd. Indian Reprint.
2. Graph theory with applications to Engineering and Computer Science - Narsingh Deo, , Prentice-Hall of India, 1993.
3. Discrete Mathematical Structure with applications to Computer Science - J. P. Trembley and R. Manohar, , McGraw Hill Book Company, 2001.
4. A First Look at Graph Theory - John Clark and Derek Allan Holton, Allied Publishers Limited.

References (For IKS part):

1. History of Hindu Mathematics, B. Datta and A. N. Singh, Bombay: Asia Publishing House, 1961
2. A history of mathematics, Victor Katz., 3rd ed, Pearson Education (Chapter 8)
3. Wikipedia articles

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester VI (Mathematics)
BS23MJ6MT2 Major-2: Abstract Algebra-II (Theory)

Hours: 4 /week

Credits: 4

Unit I:

Rings: Definitions and examples, properties, zero divisors, integral domain and Characteristic of a Ring.

Unit II:

Subrings, Ideals, Quotient Rings, Maximum Ideal, Prime Ideal, Homomorphism and Isomorphism, Kernel of homomorphism and Fundamental theorem on homomorphism.

Unit III:

Fields, Extension Field, Prime Fields, Finite Fields, Structure of a finite field and Subfields of a finite field.

Unit IV:

Polynomial Ring, The division algorithm, Reducibility Tests, Irreducibility test, Eisenstein Criterion, Unique Factorization in $\mathbb{Z}[x]$, Unique Factorization Domain and Euclidean Domain.

Reference Books:

1. Abstract Algebra (Second Edition) - I. H. Sheth, PHI Learning Pvt. Ltd.
2. Abstract Algebra (Third Edition) - I. N. Herstein, Prentice-Hall.
3. A First Course in Abstract Algebra (Third Edition) - Joseph J. Rotman, Prentice-Hall.
4. Contemporary Abstract Algebra (Nineth Edition) - Joseph A. Gallian, Cengage India Private Limited.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester VI (Mathematics)

BS23MJ6MT3 Major-3: Graph Theory and Abstract Algebra-II(Practical)

Hours: 8 /week

Credits: 4

List of Practicals:

1. Examples on definition and basic properties of graphs, matrix representation of a graph, subgraph and isomorphism of graphs.
2. Examples on walks, paths and circuits Connected Graph and components, Euler graph, Hamiltonian path and circuits.
3. Examples on Tree definition and basic properties, bridges, Rooted and binary tree.
4. Examples on Spanning tree, Fundamental circuits, Connector problems: Kruskal's algorithm and Prim's algorithm.
5. Examples on Shortest path problem: Dijkstra's algorithm , Cut sets, definition and properties.
6. Examples on connected graphs, cut vertices and connectivity.
7. Examples on Planar graphs, Kuratowski's graphs and Euler's formula.
8. Examples on Dual of a plane graph, Graph coloring and Applications of graph.
9. Problems on Rings: Definitions and examples and properties.
10. Problems on zero divisors, integral domain and Characteristic of a Ring.
11. Problems on Subrings, Ideals, Quotient Rings, Maximum Ideal and Prime Ideal.
12. Examples on Homomorphism and Isomorphism, Kernel of homomorphism and Fundamental theorem on homomorphism.
13. Problems on Fields, Extension Field, Prime Fields.
14. Problems on Finite Fields, Structure of a finite field and Subfields of a finite field.
15. Problems on Polynomial Ring, The division algorithm, Reducibility Tests, Irreducibility test and Eisenstein Criterion.
16. Problems on Unique Factorization in $\mathbb{Z}[x]$, Unique Factorization Domain and Euclidean Domain.

Reference Books:

1. Discrete Mathematics with Graph Theory (3rd ed) - Edgar G. Goodaire and Michael M. Parmenter (2011). Pearson Education Pvt. Ltd. Indian Reprint.
2. Graph theory with applications to Engineering and Computer Science - Narsingh Deo, , Prentice-Hall of India, 1993.
3. Discrete Mathematical Structure with applications to Computer Science - J. P. Trembley and R. Manohar, , McGraw Hill Book Company, 2001.
4. A First Look at Graph Theory - John Clark and Derek Allan Holton, Allied Publishers Limited.
5. Abstract Algebra (Second Edition) - I. H. Sheth, PHI Learning Pvt. Ltd.
6. Abstract Algebra (Third Edition) - I. N. Herstein, Prentice-Hall.
7. A First Course in Abstract Algebra (Third Edition) - Joseph J. Rotman, Prentice-Hall.
8. Contemporary Abstract Algebra (Ninth Edition) - Joseph A. Gallian, Cengage India Private Limited.

SHRI GOVIND GURU UNIVERSITY
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
BS23MN6MT1 Minor : Vector Calculus (Theory)

Hours: 2 /week

Credits: 2

Unit I:

Algebra of vectors, dot product and cross product of two vectors, Schwarz inequality, Orthogonal vectors, Vector projection, Application of vector products and triple product of vectors.

Unit II:

Vector equation of straight line in plane and space, Direction cosines, Vector equation of plane, Differentiation and integration, Derivative of sum, Partial differentiation of a vector function, Gradient, divergence, curl and its properties.

Reference Books:

1. Calculus and Analytic Geometry - G. B. Thomas and R. L. Finney, Pearson Education, Indian Reprint, 2010.
2. Vector Calculus, P.C. Matthew, Springer Verlag London Limited, 1998.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
4. Calculus - Stewart James, Cengage Learning, 2011.

SHRI GOVIND GURU UNIVERSITY
Choice Based Credit System (CBCS)
Syllabus for B. Sc. Semester VI (Mathematics)
BS23MN6MT2 Minor: Vector Calculus (Practical)

Hours: 4 /week

Credits: 2

Number of Practicals: 8

1. Examples on dot product and cross product of two vectors.
2. Examples on Schwarz inequality.
3. Examples on Orthogonal vectors and Vector projection.
4. Examples on Application of vector products and triple product of vectors.
5. Examples on Vector equation of straight line in plane and space and Direction cosines.
6. Examples on Vector equation of plane, Differentiation and integration.
7. Examples on Derivative of sum and Partial differentiation of a vector function.
8. Examples on Gradient, divergence and curl.

Reference Books:

1. Calculus and Analytic Geometry - G. B. Thomas and R. L. Finney, Pearson Education, Indian Reprint, 2010.
2. Vector Calculus, P.C. Matthew, Springer Verlag London Limited, 1998.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons.
4. Calculus - Stewart James, Cengage Learning, 2011.

SHRI GOVIND GURU UNIVERSITY
Syllabus for B. Sc. Semester VI (Mathematics)

BSC23SE606 Skill Enhancement Course: Operations Research

Hours: 2 /week

Credits: 2

Unit I:

Linear Programming Problem, Linear inequalities, Convex sets, Standard Form of LPP, Graphical Solution, Basic Feasible Solution, Simplex Method, Big-M method and Two Phase method.

Unit II:

Dual of LPP, Duality and simplex method, Transportation problem: Introduction, NWC method, Least-cost method and Vogel's Approximation Method, Assignment Problem: Introduction and Hungarian Method.

Skill Enhancement Course: Operations Research (Practicals)

Hours: 4 /week

Credits: 2

1. Examples on formulation of LPP and graphical method of solution of LPP.
2. Examples on simplex method.
3. Examples on Big-M method.
4. Examples on Two phase method.
5. Examples on dual simplex method.
6. Examples on NWC method and least-cost method for solution of transportation problem.
7. Examples on Vogel's Approximation method for solution of transportation problem.
8. Examples on Hungarian method for solution of assignment problem.

Reference Books:

1. Operations Research, Kanti Swaroop, Man Mohan and P.K. Gupta, Sultan Chand and Sons, 2005.
2. Operations Research: An Introduction, Hamdy A. Taha, McMillan Publishing Company, 2007.
3. Operations Research – Nita H Shah, Ravi Gor and Hardik Soni. PHI – Learning.
4. Mathematical models in O.R. - J. K. Sharma, Tata-MacGraw Hills book-company.