

Jiwaji University, Gwalior

B.Sc. Honors 2020-23

Maths Honors

First Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - I	Group Theory I	100	4	60	21	40	14
CC - II	Integral Calculus	100	4	60	21	40	14
GE - I	Computer Fundamentals	100	4	60	21	40	14
CC - I	CC – I Tutorial	100	2	100	35		
CC - II	CC – II Tutorial	100	2	100	35		
AECC - I	English Communication	100	4	60	21	40	14
	Grand Total		20				

Second Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - III	Real Analysis I	100	4	60	21	40	14
CC - IV	Vector Calculus	100	4	60	21	40	14
GE - II	Programming in C	100	4	60	21	40	14
CC - III	CC – III Tutorial	100	2	100	35		
CC - IV	CC – IV Tutorial	100	2	100	35		
AECC - II	Environmental Science	100	4	60	21	40	14
	Grand Total		20				

Third Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - V	Real Analysis II	100	4	60	21	40	14
CC - VI	Group Theory II	100	4	60	21	40	14
CC - VII	Ordinary Differential Equations	100	4	60	21	40	14
GE - III	Programming in C++	100	4	60	21	40	14
CC - V	CC – V Tutorial	100	2	100	35		
CC - VI	CC – VI Tutorial	100	2	100	35		
CC - VII	CC – VII Lab	100	2	60	21	40	14
SEC - I	Logic and Sets	100	4	60	21	40	14
	Grand Total		26				

Fourth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - VIII	Real Analysis III	100	4	60	21	40	14
CC - IX	Ring Theory	100	4	60	21	40	14
CC - X	Geometry	100	4	60	21	40	14
GE - IV	Electricity and Magnetism	100	4	60	21	40	14
CC - VIII	CC – VIII Tutorial	100	2	100	35		
CC - IX	CC – IX Tutorial	100	2	100	35		
CC - X	CC – X Lab	100	2	60	21	40	14
SEC - II	Graph Theory	100	4	60	21	40	14
	Grand Total		26				

Fifth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - XI	Numerical Methods	100	4	60	21	40	14
CC - XII	Linear Algebra I	100	4	60	21	40	14
DSE - I	Partial Differential Equations	100	4	60	21	40	14
DSE - II	Probability and Statistics	100	4	60	21	40	14
CC - XI	CC – XI Lab	100	2	60	21	40	14
CC - XII	CC – XII Tutorial	100	2	100	35		
DSE - I	DSE – I Lab	100	2	60	21	40	14
DSE - II	DSE – II Tutorial	100	2	100	35		
	Grand Total		24				

Sixth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
CC - XI	Complex Analysis	100	4	60	21	40	14
CC - XII	Linear Algebra II	100	4	60	21	40	14
DSE - III	(Any one) (a) Bio - mathematics (b) Linear Programming	100	4	60	21	40	14
DSE - IV	Mathematical Modelling	100	4	60	21	40	14
CC - XI	CC – XI Tutorial	100	2	100	35		
CC - XII	CC – XII Tutorial	100	2	100	35		
DSE - III	DSE – III Tutorial	100	2	100	35		
DSE - IV	DSE – IV Lab	100	2	60	21	40	14
	Grand Total		24				

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. I Semester
Group Theory I
Core Course

Unit – 1

Sets and Relations, Types of Relations, Equivalence relation, Equivalence classes & its properties, Fundamental Theorem on Equivalence Relation, partition of a set, Congruence Relation of \mathbf{Z} , Number Theoretic Functions: Euler's ϕ Function, Tau Function, Sigma Function.

Unit – 2

Binary Operation, Algebraic Structure, Definition and basic properties of groups, External Direct Product of Groups, subgroups, subgroups generated by a subset.

Unit – 3

Coset decomposition, Lagrange's theorem and its corollaries including Fermat's theorem, Cyclic groups and properties, Group under Addition modulo n (\mathbf{Z}_n) and its properties, Klein's Four Group and Properties, Quaternion Group and its properties.

Unit – 4

Homomorphism and its properties, Kernel of Homomorphism, Range of Homomorphism, Isomorphism and its properties.

Unit – 5

Permutation group, Cyclic Permutation, Transposition, Inversion of a Permutation, Signature of a Permutation, Partition of a Natural Number, Cycle Decomposition, Even and Odd permutations, Alternating Group, Cayley's theorem, Dihedral groups, Properties of dihedral groups.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

Reference Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
2. PB Bhattacharya, S.K- Jain and S R Nagpaul-Basic Abstract Algebra. Wiley Eastern, New Delhi, 1997.
3. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
4. Shantinarayan- A Text Book of modern Abstract Algebra, S. Chand and company, New Delhi.
5. Surjeet Singh- A text book of Modern Algebra.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

**Class
Paper
Type of Paper**

**B.Sc. I Semester
Integral Calculus
Core Course**

Unit – 1

Integration by Partial fractions, integration of rational and irrational functions, integration of algebraic functions, integration of transcendental functions.

Unit – 2

Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and their combinations, Properties of definite integrals.

Unit – 3

Quadrature, Area formula for Cartesian equations, Area bounded by two curves, Area formula for parametric equations, Area formula for polar equations, Area between two polar curves. Rectification, Arc formula for Cartesian equations, Arc formula for parametric equations, Arc formula for polar equations.

Unit – 4

Volumes and surfaces of solids of revolution, Volume formulae for Cartesian equations, Prolate and Oblate spheroids, Volume formula for parametric equations, Surface formula for Cartesian equations, Surface formula for parametric equations, Surface formula for polar equations, Beta and Gamma functions.

Unit – 5

Double and Triple integrals, Dirichlet's integrals, Liouville's extension of Dirichlet's Theorem, change of order of integration in double integrals.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Gorakh Prasad - Integral Calculus, Pothishala Pvt. Ltd. Allahabad.

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd., 2002.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. I Semester
Computer Fundamentals
Generic Elective

Unit – 1

Introduction: Introduction to computer system, uses, types of computer, generations of computer. **Computer Organisation and Architecture:** C.P.U., registers, system bus, main memory unit.

Unit – 2

Devices: Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter etc. **Memory:** Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks.

Unit – 3

Human Computer Interface: Types of software, Operating system as user interface, utility programs. **MS-Office:** Basics of MS-Word, MS-Excel and MS-PowerPoint.

Unit – 4

Computer Networks: Overview of Computer Network, Types of computer networks (LAN, WAN, MAN), Components of computer networks (Servers, workstations, network interface cards, hub, switches, cables etc.)

Unit – 5

Internet: Overview of Internet, www, IP address, URL, web pages, web browsers, Internet, Protocols, Search engines, e-mail, downloading and uploading from internet. **Overview of Emerging Technologies:** Bluetooth, cloud computing, data mining, mobile computing.

Text Books:

1. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007.
2. B. Ram, Sanjay Kumar, Computer Fundamentals: Architecture and Organization, New Age International Publishers.

Reference Books:

1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class	B.Sc. I Semester
Paper	English Communication
Type of Paper	Ability Enhancement Compulsory Course

Unit – 1

Introduction: Theory of Communication, Types and modes of Communication.

Unit – 2

Language of Communication: Verbal and Non-verbal (Spoken and Written), Personal, Social and Business Barriers and Strategies, Intra-personal, Inter-personal and Group communication.

Unit – 3

Speaking Skills: Monologue, Dialogue, Group Discussion, Effective Communication/ Mis- Communication, Interview, Public Speech.

Unit – 4

Reading and Understanding: Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Indian language to English and vice-versa), Literary/Knowledge Texts.

Unit – 5

Writing Skills: Documenting, Report Writing, Making notes, Letter writing.

Text Books:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. II Semester
Real Analysis I
Core Course

Unit – 1

Sets, Operation on sets, Function and their properties, Classification of functions, Countable and uncountable sets, Cantor Set and its properties.

Unit – 2

Real line, Archimedean property of \mathbb{R} , Bounded sets, supremum and infimum, Intervals, completeness property of \mathbb{R} , Neighborhood of a point, Adherent point, Isolation point, Accumulation point, Interior point, Exterior point, Condensation point, Frontier point, Boundary point, Open set, Closed set, Derived set, Perfect set, Dense set, Connected Set, Compact Set, Bolzano-Weierstrass theorem for sets.

Unit – 3

Real Sequence, Bounded sequence, monotonic sequences, Limit point of a sequence, Bolzano-Weierstrass theorem for sequences, Subsequence, Complementary subsequences, Limit of a sequence and its properties, Limit superior, Limit inferior, Convergent Sequence, Divergent Sequence, Cauchy Sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits.

Unit – 4

Infinite series, Sequence of partial sum, Convergent Series, Divergent Series, Necessary Condition for convergence of a series, Telescopic Series, Cauchy convergence criterion for series, positive term series, First comparison test, Second Comparison Test, convergence of p -series, Limit form comparison test, Ratio test, Raabe's Test, Cauchy's n th Root test, Cauchy's integral test (Tests of Convergence without proof).

Unit – 5

Alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence, rearrangement of series.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Mathematical Analysis by Malik & Arora, New Age International Publisher.

Reference Books:

1. R.R. Goldbeg -Real analysis, Oxford & I.B.H. publishing co., New Delhi.
2. Gabriel Klaumber- Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
3. T.M. Apostol- Mathematical Analysis, Narosa Publishing house, New Delhi, 1985.
4. D. soma sundaram and B. choudhary- A first Course in mathematical analysis, Narosa Publishing, House, New Delhi, 1997.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. II Semester
Vector Calculus
Core Course

Unit – 1

Concept of scalars and vectors, Scalar and vector product of three vectors, product of four vectors, Reciprocal vectors. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions.

Unit – 2

Vector differentiation, Gradient, divergence and curl in Cartesian and polar coordinates, Directional derivatives, Tangent plane and normal line, Tangent line and normal plane.

Unit – 3

Vector integration, Line integral, Surface integral, Volume integral, Gauss theorem (without proof), Problems based on Gauss theorem.

Unit – 4

Green's theorem (without proof) and problems based on it.

Unit – 5

Stoke's theorem (without proof) and problems based on it.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Shanti Narayan- A Text Book of Vector Calculus, S. Chand & Co., New Delhi.
3. N. Saran and S.N. Nigam-Introduction to Vector Analysis, Pothishala Pvt. Ltd, Allhabad.

Reference Books:

1. Murray R. Spiegel- Vector Analysis, schaum Publishing company, New York.
2. Shanti Narayan- A Text Book of Vector Algebra, S. Chand & Co., New Delhi.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. II Semester
Programming in C
Generic Elective

Unit – 1

Programming fundamentals – Program concept, algorithm, flow chart- Symbols rule for making flow chart, advantages and disadvantages. Evolution of programming languages: Low level, middle level, high level languages, introduction to compiler, interpreter and assembler.

Unit – 2

Fundamentals of C Program- History of C, Structure of C Program, C Tokens, data types, constants and variables, naming variables, keywords, Operator and expressions, precedence and associativity of, Type casting and type conversion in expression, formatted input output i.e. printf(), scanf().

Unit – 3

Control flow statements- If statements, if - else statement, nesting of if - else statement, else if ladder, Switch statement, go to, Break, continue, exit(), Looping controls- for, while, do – while , nested loop.

Unit – 4

Array- What is array, declaring and initialising array, types of array. String, declaration, string functions, structure and union, Storage classes: auto, static, extern, register.

Unit – 5

Function- User defined functions, library functions, function arguments and types of functions, local and global variables, calling function and called functions, call by value and call by reference, Introduction to pointer.

Text Books:

1. Programming in ANSI C by E. Balaguruswamy, Tata-McGraw Hill, New Delhi.
2. Computer fundamental by Rajaraman

Reference Books:

1. Let us C by Y. Kanetkar.
2. Brain W Kernigham & Dennis M Ritchie the C Programmed language 2 nd edition (ANSI features), Prentice Hall 1989.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class	B.Sc. II Semester
Paper	Environmental Science
Type of Paper	Ability Enhancement Compulsory Course

Unit – 1 Introduction to environmental studies

Multidisciplinary nature of environmental studies, Definition, Nature, Scope and Importance of environmental studies, Types and Components of environment, Concept of sustainability and sustainable development

Unit – 2 Ecosystems

Introduction of ecosystem, Structure and function of ecosystem, Energy flow in an ecosystem: food chains, food webs and ecological succession, Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit – 3 Natural Resources: Renewable and Non-renewable Resources

Land resources and land use change, Land degradation, soil erosion and desertification, Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations, Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state), Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit – 4 Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity, Biogeographic zones of India, Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation, Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Environmental pollution: types, causes, effects and controls, Air, water, soil and noise pollution, Nuclear hazards and human health risks.

Unit – 5 Environmental Policies & Practices

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights.

Text Books:

1. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
2. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
3. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
5. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
6. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
7. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
8. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. III Semester
Real Analysis II
Core Course

Unit – 1

Functions and their properties, some well-known functions, graphical transformation, classification of functions, limit of a function (ϵ - δ definition), Theorems on limit, Algebra of limits, Limits at infinity, Questions based on limits.

Unit – 2

Continuity, Types of Discontinuity, properties of continuous functions, Intermediate Value Property, sign retainment property, theorems on continuous functions, identity theorem, fixed point existence theorem, Uniform Continuity, Uniform Continuity theorem, Lipschitz function.

Unit – 3

Differentiability of functions, Darboux Theorem, Successive differentiation, Leibniz rule and its applications to problems of type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$

Unit – 4

Rolle's theorem, Lagrange's Mean Value theorem, Cauchy' Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$, Maxima and Minima, Indeterminate forms, L'Hopital's rule.

Unit – 5

Asymptotes, Curvature, Concavity, Convexity and Point of inflexion, Multiple points, Tracing of curves, Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Mathematical Analysis by Malik & Arora, New Age International Publisher.

Reference Books:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. Gorakh Prasad - Differential Calculus, Pothishala Pvt. Ltd. Allahabad.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. III Semester
Group Theory II
Core Course

Unit – 1

Conjugacy relation, Centre of a group, Centraliser or Normaliser, Conjugate Classes, Self-conjugate element, Counting principle and class equation of a finite group.

Unit – 2

Conjugacy of subgroups, Normal subgroups and examples, Simple group and examples, Quotient Group and examples, Maximal Subgroups.

Unit – 3

Group Automorphism, Inner Automorphism, group of Automorphisms, Internal Direct Product and its properties, First, second and third theorems of isomorphism.

Unit – 4

p-Group, p-Subgroup, p-Sylow Subgroup, Cauchy's theorem for finite abelian groups and non-abelian groups, Generalised Cayley's theorem, Index Theorem, Embedding Theorem, Corollary to Embedding Theorem.

Unit – 5

Sylow's First, Second and Third Theorem and their corollaries, Applications of Sylow's Theorem, Characteristic subgroups, Commutator subgroup and its properties.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

Reference Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
2. PB Bhattacharya, S.K- Jain and S R Nagpaul-Basic Abstract Algebra. Wiley Eastern, New Delhi, 1997.
3. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
4. Shantinarayan- A Text Book of modern Abstract Algebra, S. Chand and company, New Delhi.
5. Surjeet Singh- A text book of Modern Algebra.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. III Semester
Ordinary Differential Equations
Core Course

Unit – 1

Order and Degree of Differential Equation, Formation of Differential Equation, General, particular, explicit, implicit and singular solutions of a differential equation, separable equations and equations reducible to this form, Homogeneous equations and equations reducible to this form, linear equation and Bernoulli equations.

Unit – 2

First order exact differential equations. Integrating factors, rules to find an integrating factor, Linearly Independent Function, Linearly Dependent Function, Principle of Superposition, Wronskian: its properties and applications.

Unit – 3

Linear differential equation with constant coefficients, Homogeneous linear ordinary differential equations, Linear differential equations of second order, transformation of equations by changing the dependent variable/ independent variable, method of variation of parameters.

Unit – 4

First order and higher degree equations solvable for x , y and p , Clairaut's equation, Equations reducible to Clairaut's Form, geometrical meaning of a differential equation, orthogonal trajectories.

Unit – 5

System of Linear Differential Equations, Reduction of system of Differential Equation into Simple Differential Equation, Solution of System of Linear Differential Equation, Method of Elimination.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. D. A. Murray- Introductory Course in Differential Equations, Orient Longman (India) 1967.
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.

Reference Books:

1. G.F. Simmons - Differential Equations, Tata Mccraw Hill, 1972.
2. E.A. Codington - An Introduction to ordinary differential Equation, Prentice Hall of India, 1961.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

**Class
Paper
Type of Paper**

**B.Sc. III Semester
Programming in C++
Generic Elective**

Unit – 1

Introduction to OOPS languages: concept, characteristics of OOP's languages, benefits of OOP's, disadvantage of OOP's. Application of OOP's. **Classes & Objects:** Specifying a Class, Creating Objects, Accessing class members, Defining member function, Outside Member Functions, Accessing Member Functions within the class, inline function. **Access Specifiers:** Private, Protected and Public Members.

Unit – 2

Constructor & Destructor: Introduction, Constructor, Parameterized constructor, Multiple constructor in a class, Constructor with default argument, Copy constructor, Destructor. Array of objects, Pointers to object, Pointer to class members, friend function.

Unit – 3

Function & operator overloading: Function overloading, Overloading constructor function, Operator Overloading: Creating a member operator function, Creating Prefix & Postfix forms of the increment & decrement operation, Overloading the shorthand operation (i.e. +=, -= etc), Operator overloading restrictions.

Unit – 4

Inheritance: Base class Access control, Inheritance & protected members, Protected base class inheritance, Inheriting multiple base classes, Constructors, destructors & Inheritance.

Unit – 5

Virtual base classes, Virtual functions & Polymorphism: Virtual function, Pure Virtual functions, Early Vs. late binding. The C++ I/O system basics: C++ streams, The basic stream classes: C++ predefined streams.

Text Books:

1. C++- E. BALGURUSWAMY, TMH PUBLIC
2. Object oriented programming and C++, R.Rajaram, New Age International.

Reference Books:

1. C++ The complete reference - Herbert Schildt,- TMH Publication.
2. Object Oriented Programming C++ - R. Lafore , Pearson edu.
3. OBJECT ORIENTED PROGRAMMING WITH C++ - R. SUBBURAJ, VIKAS PUBLISHING HOUSE, NEW DELHI.
4. Mastering C++ K.R. VenuGopal, T.RaviShanker, Tata Mcgrawhill.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. III Semester
Logic and Sets
Skill Enhancement Course

Unit – 1

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit – 2

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit – 3

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle.

Unit – 4

Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

Unit – 5

Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

Text Books:

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. IV Semester
Real Analysis III
Core Course

Unit – 1

Riemann integral – Partition, Norm of a Partition, Refinement, Theorems and corollaries on Riemann integration, Integrability of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus.

Unit – 2

Fourier series of half and full intervals, Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, integral as a function of a parameter, Continuity, derivability and integrability of an integral of a function of a parameter.

Unit – 3

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit – 4

Function of two variables, Neighbourhoods, Interior points, Open and closed sets, Limit points, Real valued function on two variables, Limit of real valued functions on two variables, Continuity of real valued functions of two variables, Partial differentiation and differentiability of real-valued functions of two variables.

Unit – 5

Change of variables, Euler's theorem on homogeneous functions, Directional Derivatives, Taylor's theorem for function of two variables, Maxima and minima of functions of two variables, Schwarz's and Young's theorem, Implicit function theorem.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Mathematical Analysis by Malik & Arora, New Age International Publisher.

Reference Books:

1. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
2. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. IV Semester
Ring Theory
Core Course

Unit – 1

Definition, examples and basic properties of rings, CRU, Unit, Associate, Zero divisors, Integral Domain, Skew Field, Field, Nilpotent element, Idempotent element, Factors, Irreducible elements, Prime element, Characteristic of a ring.

Unit – 2

Subrings, Subring test, Left Ideal, Right Ideal, Ideals, Ideal Test, Ideal generated by a set, Quotient ring, Co-maximal ideal, Simple ring, Maximal Ideal, Prime ideal.

Unit – 3

Polynomial rings, Division algorithm, Remainder theorem, Factor theorem, GCD and LCM, Irreducible polynomial, Reducible polynomial, Irreducibility tests – Eisenstein's criterion.

Unit – 4

Square free number, Quadratic field, Principal Ideal, Principal ideal ring, Principal Ideal Domain (PID), Norm on an integral domain, Euclidean Domain (ED), Unique Factorization Domain (UFD), Theorems on PID, ED and UFD, Content of a polynomial, Primitive polynomial.

Unit – 5

Ring Homomorphism, Kernel of Homomorphism, Isomorphism, Isomorphism rings, Quotient rings, Some important theorems, Applications of Ring Homomorphism, Embedding of Ring, Prime field, Field of Quotients.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

Reference Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
2. PB Bhattacharya, S.K- Jain and S R Nagpaul-Basic Abstract Algebra. Wiley Eastern, New Delhi, 1997.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. IV Semester
Geometry
Core Course

Unit – 1

General equation of second degree, Centre, Equation to the conic section referred to the centre, Equation to asymptotes, nature of the conic, To find the lengths and the positions of the Axes of the conic, Eccentricity, Foci and Directrices, tracing of conics, tracing of the parabola.

Unit – 2

System of conics, common chord of two circles, equation to common chord, orthogonal curves, radical axis, radical centre, confocal conics, confocals through a given point, confocals cut at right angles, polar equation of a conic, chord joining two points, equation to tangent, polar, equation to the normal.

Unit – 3

Equation to a cone with vertex as the origin, Quadric cone through the axes, Equation of cone with given base, generators of cone, condition for three mutually perpendicular generators, Right circular cone, Tangent cone.

Unit – 4

Equation of cylinder and its properties, Right circular cylinder, enveloping cylinder and their properties.

Unit – 5

central conicoids, Paraboloid, Ellipsoid, hyperboloid of one and two sheets and their properties, Normal, polar lines, number of normals from a given point to the paraboloid.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Gorakh Prasad and H.c. Gupta-Text Book on coordinate Geometry, Pothishala Pvt. Ltd, Allahabad.

Reference Books:

1. N. Saran and S.N. Nigam-Analytical Geometry of Three Dimensions, Pothishala Pvt. Ltd, Allahabad.
2. R.J.T. Bell-Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. IV Semester
Electricity and Magnetism
Generic Elective

Unit – 1

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

Unit – 2

Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Unit – 3

Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Unit – 4

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials.

Unit – 5

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Text Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. IV Semester
Graph Theory
Skill Enhancement Course

Unit – 1

Definition, examples and basic properties of graphs, Types of graphs, Complete graph, Directed graph, Subgraph, its properties and its types, isomorphism of graphs, Homeomorphic graphs, bi-partite graphs, Connected and disconnected graphs, Rank and nullity of a graph, Some important theorems on graph.

Unit – 2

Matrix representation of graphs, Incidence matrix and its properties, Adjacency matrix, Applications of Graphs – Konigsberg Bridge Problem, Three Utilities Problem.

Unit – 3

Paths and circuits, Euler graph and its properties, Hamiltonian path and circuit, travelling salesman's problem, weighted graph, shortest path in weighted graph, Dijkstra's Algorithm for shortest paths, Floyd-Warshall algorithm.

Unit – 4

Mathematical modeling through graphs: Determination of solution of graph through modeling, guided graphs, mathematical modeling in relation to marked graphs and weighted graphs.

Unit – 5

Trees and its properties, Directed tree, Rooted tree, Decision tree, Binary tree and its properties, Spanning tree and its properties, Some theorems on trees, Centre of a tree, Minimum spanning tree, Prim's Algorithm, Kruskal's Algorithm.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.

Reference Books:

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. V Semester
Numerical Methods
Core Course

Unit – 1

Solution of Equations: Bisections, Secant, Regula Falsi, Newton's Methods. Roots of second degree polynomial equations.

Unit – 2

Interpolation: Lagrange interpolation, Divided differences, Interpolation formula using Differences. Numerical Quadrature. Newton-Cote's Formulae. Gauss Quadrature formulae.

Unit – 3

Linear equations: direct methods for solving systems of linear equations (Gauss elimination, LU decomposition, Cholesky decomposition), Iterative methods (Jacobi, Gauss-seidel reduction methods).

Unit – 4

Ordinary differential equation: Euler's method, Single step method, Runge-Kutta's method, Multistep methods, Milne Simpson method. Methods based on numerical integration, Methods based on numerical Differentiation.

Unit – 5

Different types of approximation, Least square approximation, Polynomial approximation using orthogonal polynomials, Approximation with trigonometric functions, exponential functions, rational functions.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. S.S Sastry- Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd.

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
2. Balaguruswamy-Numerical Methods, Tata McGraw Hill Publication. New York.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. V Semester
Linear Algebra I
Core Course

Unit – 1

Definition and examples of Vector spaces, subspaces, Linear dependence, independence and their basic properties, Linear span, Basis, Dimension, Existence Theorem for basis, Extension Theorem.

Unit – 2

Finite dimensional vector spaces, Existence of complementary subspaces of a subspace of a finite dimensional vector space, sum and direct sum of subspaces, Dimension of sum of subspace, Quotient space and its dimension.

Unit – 3

Matrices, Types of Matrices, Special Matrices and their properties, Normal and Echelon form of a matrix, Rank and nullity of a matrix and its properties, Linear independence of row and column matrix.

Unit – 4

Application of matrix to solve a system of linear (homogenous and non-homogenous) equations, theorems on consistency and inconsistency of a system of linear equations, solving linear equations upto three unknowns.

Unit – 5

Linear transformations, Algebra of linear transformations, Rank-Nullity theorem, Projection, Reflection, Rotation, change of basis, dual space, bi-dual space and natural isomorphism, adjoint of a linear transformation, Matrix representation of a linear transformation.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. K.B. Datta- Matrix and Linear Algebra, Prentice Hall of India Pvt Ltd. New Delhi 2000.

Reference Books:

1. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
2. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.
3. K. Hoffman and R. Kunze- Linear Algebra, 2nd Edition, Prentice Hall Englewood Cliffs. New Jersey, 1971.
4. S. Kumarsaran- Linear Algebra. A Bermetric Approach Prentice-Hall of India, 200.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. V Semester
Partial Differential Equations
Discipline Specific Elective

Unit – 1

Order and degree of partial differential equations, Classification of partial differential equations – Linear, Semi-linear, Quasi linear and non-linear partial differential equations, Formation of first order partial differential equations.

Unit – 2

Linear partial differential equation of first order, Lagrange's method, Four types of problems based on $Pp + Qq = R$, Cauchy problem for First order Quasi Linear PDE, Existence and uniqueness of integral surface passing through a given curve, Surfaces orthogonal to a given system of surfaces.

Unit – 3

Non-linear partial differential equations, Types of solutions – Complete solution, general solution and singular solution, Method of getting singular solution, Compatible systems of first order equations, Charpit's method, Curves and surfaces in three dimensions, Cauchy's method of characteristics for solving Non-linear PDE.

Unit – 4

Homogeneous and Non-homogeneous linear partial differential equation with constant coefficients, Working rule for finding complementary functions, Method of finding particular integral, Partial differential equations with variable coefficients reducible to equations with constant coefficients.

Unit – 5

Partial differential equations of second and higher orders, Classification of partial differential equations of second order, Characteristic curves and reduction to canonical forms, Heat equation and its solution, Wave equation and its solution, Laplace's equation and its solution.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Introduction to Partial Differential Equations by K.Sankara Rao, PHI
3. Elements of Partial Differential Equations by IAN N. SNEDDON Mc GRAW-HILL Book Company.

Reference Books:

1. D. A. Murray-Introductory course in differential equation, Orient Longman, India. 1967.
2. G. F. Simmons- Differential Equations, Tata Megraw Hill, 1972.
3. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
4. H.T.H. Piaggio- Elementary Treatise on Differential equations and their applications. C.B.S Publisher and Distributors, Delhi, 1985.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. V Semester
Probability and Statistics
Discipline Specific Elective

Unit – 1

Frequency Distribution- Measures of Central Tendency, Mean, Median, Mode, G.M., H.M. Partition Values, Measures of dispersion- Range, Interquartile range, Mean deviation, Standard Deviation, Moments, Skewness and Kurtosis.

Unit – 2

Theoretical Frequency Distribution- Binomial distribution, Poisson distribution, normal distribution, rectangular or uniform distribution and exponential distribution, their properties and uses.

Unit – 3

Probability- Event, Sample Space, Probability of an event, Addition and Multiplication Theorems, Baye's theorem, Continuous probability- Probability density function and its applications for finding the mean, median, mode and standard deviation of various continuous probability distributions.

Unit – 4

Mathematical expectations, Expectation of sum and product of random variables, Moment generating function.

Unit – 5

Markov Chains, Methods of least square, Curve fitting, Correlation and regression, partial and multiple correlations (upto three variables only).

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. H.C. Saxena and J.N.Kapoor, Mathematical Statistics, S. Chand and Company.
3. M.Ray- Statistical Methods.

Reference Books:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. VI Semester
Complex Analysis
Core Course

Unit – 1

Polar form of a Complex Number, Point set topology on the complex plane, Limit, Continuity and Differentiability, Cauchy – Riemann Equation, Complex form of C – R Equation, Necessary condition for Differentiability, Sufficient condition for Differentiability.

Unit – 2

Regular Point, Analytic Functions, Singularity, Classification of Singular Points, Entire Functions, Results on Analyticity, Construction of Analytic Function.

Unit – 3

Complex Integration, Curves, Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy- Goursat theorem, Cauchy's Integral Formula, Cauchy Integral Formula for the derivative of an Analytic Function, Morera's Theorem, Analytic functions on simply connected domains.

Unit – 4

Liouville's theorem and the fundamental theorem of algebra, Power Series, Radius of Convergence, Results on radius of convergence, Taylor series expansion, Laurent series expansion, Analysis of Singularities through Laurent Series, Meromorphic Function.

Unit – 5

Conformal Mapping, Magnification factor, Bilinear or Mobius transformation, Fixed points, Canonical form of a Bilinear Transformation, Cross Ratio.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. Ponnuswamy- complex Analysis, Narosa Publication, New Delhi.

Reference Books:

1. L.V Ahlfors, Complex Analysis Mc Graw Hill, New York.
2. Walter Rudin- Real and complex Analysis, Mc Graw Hill, New York.
3. R.V. Churchill & J.W. Brown, Complex Variables and Application, 5th Edition , Mc Graw Hill, New York, 1990.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. VI Semester
Linear Algebra II
Core Course

Unit – 1

Characteristic polynomial, Characteristic equations of a matrix, Cayley Hamilton theorem and its use in finding inverse of a matrix, Monic polynomial, Minimal polynomial, Companion matrix, Eigen values and eigen vectors of a linear transformation, Eigen space, Geometric multiplicity, Algebraic multiplicity, Gershgorin Theorem.

Unit – 2

Similarity of Matrices and diagonalization, properties on similarity of matrices, Diagonalization of Linear Operator, Conditions of diagonalizability, Theorem on diagonalization, Diagonalizability of important matrices, Permutation matrix.

Unit – 3

Canonical forms, Primary Decomposition Theorem, Cyclic Decomposition Theorem, Jordan Block, Jordan Canonical Form, Propositions of Jordan Canonical form, Applications of Jordan Canonical Form.

Unit – 4

Inner Product, Inner product space, Gram Schmidt Orthogonalization Process, Orthogonal Projection, Isomorphism and Unitary Operations, Adjoint of a linear transformation, Unitary Operator, Normal Operator, Self Adjoint Operator.

Unit – 5

Dual Space, Bilinear Form, Quadratic Form, Definite, Semi-definite and Indefinite Quadratic Forms, Criterion for definiteness of a Real Quadratic Form.

Text Books:

1. Books of Madhya Pradesh Hindi Granth Academy
2. K.B. Datta- Matrix and Linear Algebra, Prentice Hall of India Pvt Ltd. New Delhi 2000.

Reference Books:

1. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
2. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.
3. K. Hoffman and R. Kunze- Linear Algebra, 2nd Edition, Prentice Hall Englewood Cliffs. New Jersey, 1971.
4. S. Kumarsaran- Linear Algebra. A Bermetric Approach Prentice-Hall of India, 200.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. VI Semester
Bio - Mathematics
Discipline Specific Elective

Unit – 1

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat.

Unit – 2

Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system.

Unit – 3

Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.

Unit – 4

Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.

Unit – 5

Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Text Books:

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.
2. J. D. Murray, *Mathematical Biology*, Springer, 1993.

Reference Books:

1. Y. C. Fung, *Biomechanics*, Springer-Verlag, 1990.
2. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.
3. Dr V.P. Saxena- Bio-Mathematics
4. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. VI Semester
Linear Programming
Discipline Specific Elective

Unit – 1

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit – 2

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Unit – 3

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem.

Unit – 4

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit – 5

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Text Books:

1. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.
2. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.

Reference Books:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.

JIWAJI UNIVERSITY, GWALIOR
B.Sc. Honors Mathematics: 2020-2023

Class
Paper
Type of Paper

B.Sc. VI Semester
Mathematical Modelling
Discipline Specific Elective

Unit – 1

Series solutions of differential equations, Power series method, Bessel and Legendre's equations, Bessel's and Legendre's functions and their properties- recurrence and generating function. Orthogonality of functions.

Unit – 2

Laplace Transformation, Linearity of the Laplace transformation, Existence theorem for Laplace transforms, Laplace transforms of derivatives and integrals, Shifting theorems, Differentiation and integration of transforms.

Unit – 3

Inverse Laplace transforms, Convolution theorem, Application of Laplace transformation for solving initial value problems of second order linear differential equations with constant coefficients.

Unit – 4

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence.

Unit – 5

Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis.

Text Books:

1. J.N. Kapur- Mathematical Modeling, New Age International publishers.
2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

Reference Books:

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

