

**JIWAJI UNIVERSITY, GWALIOR**  
**B.Sc. Honors Mathematics: 2021-2025**

**First Semester:**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - I</b>	Group Theory-I	100	5	60	21	40	14
<b>MNR - I</b>	Integral Calculus	100	5	60	21	40	14
<b>GEC - I</b>	Computer Fundamentals	100	4	60	21	40	14
<b>AEC - I</b>	English Communication	100	4	60	21	40	14
<b>MJR - I</b>	MJR – I Tutorial	100	1	100	35		
<b>MNR - I</b>	MNR – I Tutorial	100	1	100	35		
	<b>Grand Total</b>		<b>20</b>				

**MJR = Major Course**

**GEC = Generic Elective Course**

**MNR = Minor Course**

**AEC = Ability Enhancement Course**

**Second Semester:**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - II</b>	Real Analysis-I	100	5	60	21	40	14
<b>MNR - II</b>	Vector Calculus	100	5	60	21	40	14
<b>GEC - II</b>	Linear Programming	100	4	60	21	40	14
<b>AEC - II</b>	Environmental Science	100	4	60	21	40	14
<b>MJR - II</b>	MJR – II Tutorial	100	1	100	35		
<b>MNR - II</b>	MNR – II Tutorial	100	1	100	35		
	<b>Grand Total</b>		<b>20</b>				

### Third Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
MJR - III	Group Theory-II	100	5	60	21	40	14
MNR - III	Ordinary Differential Equations	100	5	60	21	40	14
GEC - III	Probability and Statistics	100	4	60	21	40	14
SEC - I	Programming in C	100	4	60	21	40	14
MJR - III	MJR – III Tutorial	100	1	100	35		
MNR - III	MNR – III Tutorial	100	1	100	35		
	<b>Grand Total</b>		<b>20</b>				

SEC = Skill Enhancement Course

### Fourth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
MJR - IV	Real Analysis-II	100	5	60	21	40	14
MNR - IV	Ring Theory	100	5	60	21	40	14
GEC - IV	Bio – Mathematics	100	4	60	21	40	14
SEC - II	Programming in C++	100	4	60	21	40	14
MJR - IV	MJR – IV Tutorial	100	1	100	35		
MNR - IV	MNR – IV Tutorial	100	1	100	35		
	<b>Grand Total</b>		<b>20</b>				

## Fifth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - V</b>	Partial Differential Equations	100	5	60	21	40	14
<b>DSE - I</b>	Linear Algebra-I	100	4	60	21	40	14
<b>SEC - III</b>	Internet and E - Commerce	100	4	60	21	40	14
<b>MJR - V</b>	MJR – V Tutorial	100	1	100	35		
	Internship/ Apprenticeship	75	4				
	Evaluation of Report	25	2				
	<b>Grand Total</b>		<b>20</b>				

DSE = Discipline Specific Elective

## Sixth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - VI</b>	Real Analysis-III	100	5	60	21	40	14
<b>DSE - II</b>	Linear Algebra-II	100	4	60	21	40	14
<b>DSE - III</b>	Discrete Mathematics	100	4	60	21	40	14
<b>MJR - VI</b>	MJR – VI Tutorial	100	1	100	35		
	Internship/ Apprenticeship	75	4				
	Evaluation of Report	25	2				
	<b>Grand Total</b>		<b>20</b>				

## Seventh Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - VII</b>	Complex Analysis	100	5	60	21	40	14
<b>DSE - IV</b>	Mathematical Modelling	100	4	60	21	40	14
<b>MNR - V</b>	Research Methodology	100	3	60	21	40	14
<b>MJR - VII</b>	MJR – VII Tutorial	100	1	100	35		
<b>MNR - V</b>	MNR – V Tutorial	100	1	100	35		
	Internship	75	4				
	Evaluation of Report	25	2				
	OR	OR	OR				
	<b>Research Project</b>						
	Evaluation of Thesis	50	4				
	Pre-submission viva-voce	25	1				
	External viva-voce	25	1				
	<b>Grand Total</b>		<b>20</b>				

## Eighth Semester:

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Internal Exam Marks	
				MAX	MIN	MAX	MIN
<b>MJR - VIII</b>	Numerical Methods	100	4	60	21	40	14
<b>MNR - VI</b>	Geometry	100	4	60	21	40	14
<b>MJR - VIII</b>	MJR – VIII Practical	100	2	60	21	40	14
	Internship	75	6				
	Evaluation of Report	25	4				
	OR	OR	OR				
	<b>Research Project</b>						
	Evaluation of Thesis	50	6				
	Pre-submission viva-voce	25	2				
	External viva-voce	25	2				
	<b>Grand Total</b>		<b>20</b>				

**JIWAJI UNIVERSITY, GWALIOR**  
**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. I Semester**  
**Group Theory-I**  
**Major 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  $\phi$  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. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
2. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy.
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.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. I Semester**  
**Integral Calculus**  
**Minor 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. Gorakh Prasad - Integral Calculus, Pothishala Pvt. Ltd. Allahabad.
2. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd., 2002.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. I Semester**  
**Computer Fundamentals**  
**Generic Elective Course**

**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.

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<b>Class</b>	<b>B.Sc. I Semester</b>
<b>Paper</b>	<b>English Communication</b>
<b>Type of Paper</b>	<b>Ability Enhancement Course</b>

**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.



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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. II Semester**  
**Real Analysis-I**  
**Major 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 nth 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. Mathematical Analysis by Malik & Arora, New Age International Publisher.
2. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. T.M. Apostol- Mathematical Analysis, Narosa Publishing house, New Delhi, 1985.

**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. Books of Madhya Pradesh Hindi Granth Academy.
4. D. soma sundaram and B. choudhary- A first Course in mathematical analysis, Narosa Publishing, House, New Delhi, 1997.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. II Semester**  
**Vector Calculus**  
**Minor 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. Shanti Narayan- A Text Book of Vector Calculus, S. chand & Co., New Delhi.
2. 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.
3. Books of Madhya Pradesh Hindi Granth Academy

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. II Semester**  
**Linear Programming**  
**Generic Elective Course**

**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.

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<b>Class</b>	<b>B.Sc. II Semester</b>
<b>Paper</b>	<b>Environmental Science</b>
<b>Type of Paper</b>	<b>Ability Enhancement Course</b>

**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.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. III Semester**  
**Group Theory-II**  
**Major 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. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
2. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy.
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.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. III Semester**  
**Ordinary Differential Equations**  
**Minor 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. D. A. Murray- Introductory Course in Differential Equations, Orient Longman (India) 1967.
2. 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.
3. Books of Madhya Pradesh Hindi Granth Academy.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. III Semester**  
**Probability and Statistics**  
**Generic 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. H.C. Saxena and J.N.Kapoor, Mathematical Statistics, S. Chand and Company.
2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
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. Books of Madhya Pradesh Hindi Granth Academy.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. III Semester**  
**Programming in C**  
**Skill Enhancement Course**

**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.



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**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. IV Semester**  
**Real Analysis-II**  
**Major Course**

**Unit – 1**

Functions of one variable and their properties, some well-known functions, graphical transformation, classification of functions, limit of a function ( $\epsilon$ - $\delta$  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 retention 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, Leibnitz 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's Mean Value Theorem, 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. Mathematical Analysis by Malik & Arora, New Age International Publisher.
2. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Gorakh Prasad - Differential Calculus, Pothishala Pvt. Ltd. Allahabad.

**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. Books of Madhya Pradesh Hindi Granth Academy.
4. T.M. Apostol- Mathematical Analysis, Narosa Publishing house, New Delhi, 1985.

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**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. IV Semester**  
**Ring Theory**  
**Minor 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. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
2. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy.
2. PB Bhattacharya, S.K- Jain and S R Nagpaul-Basic Abstract Algebra. Wiley Eastern, New Delhi, 1997.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. IV Semester**  
**Bio - Mathematics**  
**Generic 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, Stage Structure Models, Age Structure Models.

**Unit – 2**

Harvesting a single natural population, Optimal Exploitation models, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS).

**Unit – 3**

Insect Outbreak Model: Spruce Budworm. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions.

**Unit – 4**

Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Travelling wave solutions.

**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, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model).

**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.

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**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. IV Semester**  
**Programming in C++**  
**Skill Enhancement Course**

**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.

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**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. V Semester**  
**Partial Differential Equations**  
**Major Course**

**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. Elements of Partial Differential Equations by IAN N. SNEDDON Mc GRAW-HILL Book Company.
2. Introduction to Partial Differential Equations by K.Sankara Rao, PHI

**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.
5. Books of Madhya Pradesh Hindi Granth Academy.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. V Semester**  
**Linear Algebra-I**  
**Discipline Specific Elective**

**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. K.B. Datta- Matrix and Linear Algebra, Prentice Hall of India Pvt Ltd. New Delhi 2000.
2. K. Hoffman and R. Kunze- Linear Algebra, 2nd Edition, Prentice Hall Englewood Cliffs. New Jersey, 1971.

**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. Books of Madhya Pradesh Hindi Granth Academy.
4. S. Kumarsaran- Linear Algebra. A Bermetric Approach Prentice-Hall of India, 2000.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. V Semester**  
**Internet and E - Commerce**  
**Skill Enhancement Course**

**Unit – 1**

**Evolution of networking:** Introduction to computer networks, types of networks (PAN, LAN, MAN, WAN), networking topologies.

**Network devices:** Modem, Ethernet card, RJ45, Repeater, Hub, Switch, Router, Gateway.

**Unit – 2**

**Data communication Terminologies:** concept of communication, components of data communication (sender, receiver, message, communication media, protocols), measuring capacity of communication media (bandwidth, data transfer rate), IP address, switching techniques.

**Transmission media:** Wired communication media (Twisted pair cable, Co-axial cable, Fiber-optic cable), Wireless media (Radio waves, Micro waves, Infrared waves).

**Unit – 3**

**Internet** – Early Ages of Internet; Introduction to Internet, evolution of networking (ARPANET, NSFNET, INTERNET), Characteristics of Internet; Components of Internet – Internet Services, Elements of Internet, Internet Protocol. History of the World Wide Web, basic., URL, WWW and its applications - Web, email, Chat, VoIP. Website: Introduction, difference between a website and webpage, Web Browsers: Introduction, commonly used browsers.

**Unit – 4**

**Introduction to E-Commerce:** Defining Commerce; Main Activities of Electronic Commerce; Benefits of E-Commerce; Broad Goals of Electronic Commerce; Main Components of E-Commerce; Functions of Electronic Commerce – Communication, Process Management, Service Management, Transaction Capabilities; Role of Internet and Web in E-Commerce.

**Unit – 5**

**E-commerce business models and concepts:** E-commerce business models, Major business-to consumer (B2C) business models, Major business-to-business (B2B) business models, Business models in emerging E-commerce areas, How the internet and the Web change business. **Security and Encryption:** The E-commerce security environment, Security threats in the Ecommerce environment, Technology solutions, Policies, Procedures and Laws.

**Text Books:**

1. Elias. M. Awad, “Electronic Commerce”, Prentice Hall of India Pvt. Ltd.
2. Kenneth C. Laudon, E-Commerce: Business, Technology, Society, 4<sup>th</sup> Edition, Pearson.
3. Internet and World Wide Web How to program, P.J. Deitel and H.M. Deitel, Pearson.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. VI Semester**  
**Real Analysis-III**  
**Major 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. Mathematical Analysis by Malik & Arora, New Age International Publisher.
2. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Walter Rudin- Real and complex Analysis, Mc Graw Hill, New York.

**Reference Books:**

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



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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. VI Semester**  
**Linear Algebra-II**  
**Major 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. K.B. Datta- Matrix and Linear Algebra, Prentice Hall of India Pvt Ltd. New Delhi 2000.
2. K. Hoffman and R. Kunze- Linear Algebra, 2nd Edition, Prentice Hall Englewood Cliffs. New Jersey, 1971.

**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. Books of Madhya Pradesh Hindi Granth Academy.
4. S. Kumarsaran- Linear Algebra. A Bermetric Approach Prentice-Hall of India, 2000.

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<b>Class</b>	<b>B.Sc. VI Semester</b>
<b>Paper</b>	<b>Discrete Mathematics</b>
<b>Type of Paper</b>	<b>Discipline Specific Elective</b>

**Unit – 1**

Relation: Product set, Composition of relations, Types of relations, Partition of a set, Partial order relation, Partially ordered sets, totally ordered sets, Hasses diagram, Maximal and minimal element, first and last element, Lattice- definition and examples, dual lattice, bounded lattice, distributive lattice, complemented lattice.

**Unit – 2**

Propositions, truth table, negation, Boolean functions - conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

**Unit – 3**

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.

**Unit – 4**

Paths and circuits, Euler graph and its properties, Hamiltonian path and circuit, travelling salesman's problem, weighted graph, shortest path in weighted graph. 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.

**Unit – 5**

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

**Text Books:**

1. Narsingh Deo, *Graph Theory with applications to Engineering and Computer Science*, Prentice Hall Inc.
2. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
3. 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. Books of Madhya Pradesh Hindi Granth Academy.
1. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
2. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.
3. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. VII Semester**  
**Complex Analysis**  
**Major 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. Ponnuswamy- complex Analysis, Narosa Publication, New Delhi.
2. Walter Rudin- Real and complex Analysis, Mc Graw Hill, New York.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy
2. L.V Ahlfors, Complex Analysis Mc Graw Hill, New York.
3. R.V. Churchill & J.W. Brown, Complex Variables and Application, 5<sup>th</sup> Edition , Mc Graw Hill, New York, 1990.

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**B.Sc. Honors Mathematics: 2021-2025**

**Class**  
**Paper**  
**Type of Paper**

**B.Sc. VII 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.

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<b>Class</b>	<b>B.Sc. VII Semester</b>
<b>Paper</b>	<b>Research Methodology</b>
<b>Type of Paper</b>	<b>Minor Course</b>

**Unit – 1**

Research: Meaning, Objectives, Motivation and Types, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of knowing how research is done, Research Process, Criteria of good research, Problems encountered by researchers in India.

**Unit – 2**

What is a research problem, Selecting the problem, Necessity of defining the problem, Technique involved in defining a problem.

**Unit – 3**

Meaning of Research Design, Need for Research Design, Features of a good design, Important concepts relating to research design, Different research designs, Basic Principles of Experimental Designs.

**Unit – 4**

Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation.

**Unit – 5**

Significance of Report Writing, Different steps in writing report, Layout of a research report, Types of report, Oral Presentation, Mechanics of writing a research report, Precautions for writing research reports.

**Text Books:**

1. C.R. Kothari - Research Methodology, New Age International Publishers.

**Reference Books:**

1. Yogesh Kumar Singh – Fundamentals of Research Methodology and Statistics, New Age International Publishers.
2. Ranjit Kumar - Research Methodology, A step-by-step guide for beginners, SAGE Publications Ltd.

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**Class  
Paper  
Type of Paper**

**B.Sc. VIII Semester  
Numerical Methods  
Major Course**

**Unit – 1**

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

**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, Choleskydecomposition), 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. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., Newage International Publisher, India, 2007.
2. S.S Sastry- Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd.

**Reference Books:**

1. Balaguruswamy-Numerical Methods, Tata McGraw Hill Publication. New York.
2. Books of Madhya Pradesh Hindi Granth Academy.

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**Class**  
**Paper**  
**Type of Paper**

**B.Sc. VIII Semester**  
**Geometry**  
**Minor 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. N. Saran and S.N. Nigam-Analytical Geometry of Three Dimensions, Pothishala Pvt. Ltd, Allahabad.
2. Gorakh Prasad and H.c. Gupta-Text Book on coordinate Geometry, Pothishala Pvt. Ltd, Allahabad.

**Reference Books:**

1. Books of Madhya Pradesh Hindi Granth Academy.
2. R.J.T. Bell-Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.