Department
of
Mathematics and Statistics

School of Mathematical and Physical Science

Curriculum Framework
B.A./ B.Sc.-Mathematics

Based on National Education Policy- 2020

Date of BoS – 12/12/2023

Doctor Harisingh Gour Vishwavidyalaya
(A Central University)
Sagar-Madhya Pradesh-470003

Passed by Board of Studies Dated 12/12/23

Passed by School Board Dated 13/12/23

About the Department:

The Department of Mathematics & Statistics was established with the very inception of the University in the year of 1946. The founder of the university and the founder vice-chancellor Dr. Harisingh Gour had himself appointed Mr. R.B. Rabugunday as the first Head of the Department. Mr. Rabugunday was a scholar of Madras University and a Wrangler of Cambridge tradition.

Curriculum Framework based on National Education Policy-2020

NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader. In the same spirit, we at Department of Mathematics and Statistics have developed a curriculum framework to encompass the goals of NEP 2020. To this end, we have incorporated choice of subject/disciplines of study, creating academic pathways having constructive combinations of disciplines for study with multiple entry and exit points aswell as focus on **experiential learning** for students by introducing **multidisciplinary and skill enhancement courses** and actual Hand's on training in the recent and trending aspects of

1. **Mathematical Science**

Under Graduate Curriculum Framework for Bachelor of Science

1. **Name of the Programme: (1) Certificate in Science (After exit of one year)**

   (2) Diploma in Science (After exit of two years)

2. **About the Programme:**

   Mathematics is backbone of all discipline. Aim of this programme is to train young minds to handle the critical problems that occur in Mathematical Sciences as well as in real life.

3. **Objectives of the Programme**

   - To develop students' skills in mathematical science through various tools and techniques.
   - To provide rigorous instruction in fundamental mathematical concepts and skills presented in the context of real-world applications.
   - To introduce students to the enormous diversity and complexity of real life problems in Mathematics.
   - To provide the opportunity to gain familiarity with the applications of mathematics.

4. **Programme Learning Outcomes :**

   The programme learning outcomes are attained by learners through the essential learnings acquired on completion of selected courses of study within a programme. The outcomes and attributes described in qualification descriptors are attained by students through learning acquired on completion of a programme of study.

a) After completion of this program of study the students will have an enhanced knowledge and understanding of mathematics.

b) The Mathematical skills learned through this course will provide analytical understanding for approaching problems that the students encounter in real life situations.

c) Students who will pass out this course be better able to draw inferences that rest on mathematical logics.

D Shukla 12/12/23
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बोर्ड ऑफ स्टडीज (बी. ओ. एस.)
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5. Structure of the Programme (B.A./B.Sc.) for: (1) Certificate in Science (After exit of one year)

	Semester I				
Level 5	**Nature of Course**	**Course Code**	**Course Title**	**Credits**	**Course Designer**
	Discipline Specific Major	MTS-DSM-111	Calculus	6	Dr. U.K.Khedlekar
	Multi-Disciplinary Major	MTS-MDM-111	Matrix Theory	6	Dr. Bhupendra
	Ability Enhancement Course	MTS-AEC-111	Graph Theory	2	Dr. K.Shrivastava
	Skill Enhancement Course	MTS-SEC-111	Vector Calculus	2	Dr. Bhupendra
	Semester II				
	Nature of Course	**Course Code**	**Course Title**	**Credits**	**Course Designer**
	Discipline Specific Major	MTS-DSM-211	Basic Algebra	6	Dr. U.K.Khedlekar
	Multi-Disciplinary Major	MTS-MDM-211	Numerical Methods	6	Dr. R.K.Pandey
	Ability Enhancement Course	MTS-AEC-211	Fundamental of Computer	2	Prof. D.Shukla
	Skill Enhancement Course	MTS-SEC-211	Boolean Algebra	2	Dr. K.Shrivastava

Structure of the Programme (B.A./B.Sc.) for: (2) Diploma in Science (After exit of two years)

	Semester III				
Level 6	**Nature of Course**	**Course Code**	**Course Title**	**Credits**	**Course Designer**
	Discipline Specific Major	MTS-DSM-311	Differential Equations	6	Dr. U.K. Khedlekar
	Multi-Disciplinary Major	MTS-MDM-311	Mechanics	6	Dr. Bhupendra
	Ability Enhancement Course	MTS-AEC-311	Portfolio Optimization	2	Dr. M.K.Yadav
	Semester IV				
	Nature of Course	**Course Code**	**Course Title**	**Credits**	**Course Designer**
	Discipline Specific Major	MTS-DSM-411	Real Analysis-I	6	Dr. R.K. Pandey
	Multi-Disciplinary Major	MTS-MDM-411	Metric Space	6	Dr. K. Shrivastava
	Skill Enhancement Course	MTS-SEC-411	Tautology	2	Dr. Bhupendra

6. **Exit: (1) Certificate in Science (After exit of one year)**
   (2) Diploma in Science (After exit of two years)
7. **Teaching Learning Approach:**
   Mainly this programme will transact the under given pedagogic approach-
   - Lecture/ Seminar format
   - Demonstration
   - Readings/written assignments and Field Projects
   - Group discussions/tutorial Community visit
   - Project work
   - Field Visit/Survey/Dissertation

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8. **Assessment**
   The learner in the programme will be assessed throughout the duration of the programme in a formative and summative evaluations i.e. Mid (I&II) and End Semester examinations. To be eligible to appear in End semester examination a student must appear in Mid semester examinations along with 75 per cent attendance in classroom processes

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester I (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem I	MTS-DSM-111	Calculus	5	1	0	6	IA(Mid)-40 EA(End Sem)-60	Dr.U.K. Khedlekar

Lectures Hrs: 90

Learning Objectives: This course will enable the students to:
Understand the basic tools of Calculus so that they can view and analyze the real worldproblem. Calculate the limit and examine the continuity and understand the geometricalinterpretation of differentiability. Understand the consequences of various mean value theorems.
Draw curves in Cartesian and polar coordinate systems.

Course Learning Outcomes:

CO 1 After completion of the course students will be able to understand the application of Rolle's Theorem, Mean Value Theorem and Lagrange's Theorem in industry.

CO 2 Understand the fundamental properties of the real numbers, including completeness and Archimedean, and density property of rational numbers in R.

CO 3 By plotting (trace) curves, they understand the characteristics of different curves inCartesian and polar coordinates.

Unit wise Learning Outcomes:

UO 1: This course will enable the students to understand continuity and differentiability in terms of limits and graphs of certain functions.

UO 2: To understand higher order derivatives and Applications.

UO 3: Describe asymptotic behavior in terms of limits involving infinity. Use derivatives to explorethe behavior of a function.

UO 4: The students will be able to use basic tools of analysis related to functions.

UO 5: The students will understand how useful double and triple integrals.

Unit-I: Continuity, ε-δ definition of limit and continuity of a real valued function; Differentiability and its geometrical interpretation, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometrical interpretations, Darboux's theorem. boundedness of continuous function on the closed interval.
Unit-II: Successive differentiation and Leibnitz theorem, Maclaurin's and Taylor's theorems for expansion of a function, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlömilch forms of remainder
Unit-III: Curvature, Asymptotes and Curve Tracing: Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes, Symmetry, Concavity and convexity, Points of inflection,Tangents at origin, Multiple points, Position and nature of double points, Tracing of Cartesian, polar and parametric curves.
Unit-IV: Limit, continuity and first order partial derivatives, Higher order partial derivatives, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem, Total differentiation and Jacobians.
Unit-V: Double integration over rectangular and non rectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals.

Essential Readings

1. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus* (10th edition). Wiley India.
2. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas' Calculus* (14th edition). Pearson Education.

Suggested Readings

1. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
2. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
3. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.
4. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic Multivariable Calculus*, Springer India Pvt. Limited.

Essential e-Resources

1. Link-NPTEL Mathematics - NOC:Basic Calculus 1
2. Link-Calculus Of One Real Variable - Course (nptel.ac.in)

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester I (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem I	MTS–MDM - 111	Matrix Theory	5	1	0	0	IA (Mid) – 40 EA (End Sem) - 60	Dr. Bhupendra

Lecture Hrs. 60

Learning Objectives:

- To understand the basic concept of matrices and their types
- To familiar with the application of Caley Hamilton theorem in finding inverse of matrix.
- To provide an introduction of Matrices to real life problems

Course Learning Outcomes:

CO 1: Students should have an enhanced knowledge and understanding of Matrix theory
CO 2: The course skills should provide several methods for approaching problems students encounter in their future endeavors.
CO 3: Students should be better able to understand matrix concept in terms of linear map.

Unit wise Learning Outcomes

UO 1: Students should be able to determine the rank of matrix and elementary operation to convert into Echelon form, normal form, etc.
UO 2: Students should be able to evaluate eigen values and eigenvectors of various square matrices.
UO 3: Students should be able to solve system of linear equations through matrix methods
UO 4: Students should be able to understand matrix into linear map and vice-versa.
UO 5: Students should be acquainted with the knowledge of MATLAB and applications matrices into real life problems.

Unit I:	Matrix algebra, Row and column vectors of a matrix, row rank and column rank, Echelon matrix, reduced Echelon matrix, rank of a matrix, normal form of a matrix, inverse of matrix.
Unit II:	Square matrices, square block matrices, eigen values and eigenvectors of a matrix, relationship between eigen values and eigenvectors, nature of eigen values of special types of matrices, the process of finding eigen values and the eigenvectors
Unit III:	Cayley-Hamilton theorem and its use in finding of inverse, application of matrices to system of linear equations, consistency and inconsistency,
Unit IV:	Matrix as a linear map: subspace and span, basis and dimension, linear transformation, coordinate vectors, coordinate matrices, change of the basis matrix, equivalence and similarity.
Unit V:	MATLAB basics, practical approach of matrices through MATLAB, applications of matrices in real world problems,

Essential Readings

1. Joel L. Franklin, Matrix theory, Dover Publication 2012.
2. David W Lewis, Matrix theory. World scientific, 1991.

Suggested Readings

1. Fuzhen Zhang, Matrix theory, Basic results and Techniques, Springer 2011.
2. Leonard E Fuller, Basci Matrix theory, Dover Publication 2017.

Essential e-Resources

1. https://www.scribd.com/book/271620206/Matrix-Theory
2. https://link.springer.com/book/10.1007/978-3-030-80481-7

12/12/23

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Department of M... and Statistics
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Dr. H.S. Gour Vishwavidyalaya, Sagar, M.P.

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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester I (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem I	MTS-AEC-111	Graph Theory	2	0	0	2	IA (Mid)-40 EA (End Sem)- 60	Dr. Kavita Shrivastava

Lectures Hrs: 30

Learning Objectives:

1. Students will achieve command of the fundamental definitions and concepts of graph theory.
2. To study proof techniques related to various concepts in graphs.
3. To explore modern applications of graph theory.
4. Able to apply theoretical knowledge acquired to solve realistic problems in real life.

Course Learning Outcomes:

CO1: Understand the basic concepts of graphs, and different types of graphs.
CO2: Understand the properties, theorems and be able to prove theorems.
CO3: Apply suitable graph model and algorithm for solving applications.
CO4: Understand the Travelling Salesman's problem.
CO5: Form Dijkstra'salgorithm and apply it in various situations.

Unit Wise Learning Outcomes:

UO1. To learn about graph and its properties.
UO2. To learn about types of graph .
UO3 To learn about travelling salesman problem and its application
UO4. Aware about planar graph.
UO5. Aware about shortest path, trees and its properties.

Unit I : Definition, examples and basic properties of graphs, graph terminology, types of graph, path, trail, circuit, cycle, complementary graph.
Unit II : Sub graphs, Spanning Subgraph, Isomorphic Graph, Homoeomorphic graph, Connected graph, Disconnected graph, Cut set, Cut point, Complete graph, Labeled graph, Weight graph, Regular graph, Bipartite graph, Complete bipartite graph.
Unit III: Definitions: Directed and undirected graphs. Hand shaking property and its problems. Real life applications Applications- Konigsberg bridge problem, Utility problem and travelling salesman problem. Euler graphs and Hamiltonian graphs (no theorems) problems.
Unit IV : Planar graph, Properties of planar graph, Non- planar graph, Euler formula, Kuratowski's theorem, Graph coloring.
Unit V : Shortest path, Dijkstra's algorithm, Trees and their properties, Spanning tree, Kruskal's algorithms.

Essential Reading:

1. Narasingh Deo, Graph Theory with applications to engineering and computer Science, Edition, Printice hall of India Private Limited, 2009.
2. Ralph P. Grimaldi., Discrete and Combinatorial Mathematics, 5th Edition , Pearson, 2006.

Suggested Reading

1. Geir Agnarsson and Raymond Greenlaw, Graph Theory, Modeling, Applications and Algorithms, 1st Edition, Pearson Education, Inc, New Delhi 2009.
2. John Clark and Holton D.A, A First Look at Graph Theory, Edition, Allied Publishers, 2001.
3. Douglas B West, Introduction to Graph Theory, 2nd Edition, Printice hall of India Private Limited, New Delhi.

12/12/23
अध्यक्ष / Chairman
बोर्ड ऑफ स्टडीज (यू.जी.एस.)
Board of Studies (UGS)
गणित एवं सांख्यिकी विभाग
Department of Mathematics and Statistics
डॉ. हरिसिंह गौर विश्वविद्यालय, सागर म.प्र.

Passed by Board of Studies Dated. 13/12/23 Passed by School Board Dated 13/12/23

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester I (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem I	MTS-SEC-111	Vector Calculus	2	0	0	2	IA (Mid)-40 EA(End Sem)- 60	Dr.U.K.Khedlekar Dr. Bhupendra

Lectures Hrs: 30

Learning Objectives:

To understand the concept of differentiation of vector function, and applications of Scalar and vector product. To understand the aspects of gradient, divergence and curl.

Course Learning Outcomes:

CO1: Students capable to understand the vector valued function.
CO2: After completion of this course, students should be able to manipulate vectors to perform geometrical calculations in three dimensions.
CO3: They will also able to calculate and interpret derivatives in up to three dimensions.

Unit Wise Learning Outcomes:

UO1: To learn about vectors and Scalar
UO2: To learn about partial differentiation of vector function.
UO3: To learn about derivative of sum and dot product.
UO4: To find out the derivative of cross product of two vectors.
UO5: To discuss about gradient, divergence and curl.

Unit – I: Differentiation of a vector function and Partial differentiation of a vector function.
Unit – II: Derivative of sum and dot product of two vectors and their properties.
Unit – III: Derivative of cross product of two vectors and their properties.
Unit – IV: Work done and moment by force.
Unit – V: Gradient, divergence and curl.

Essential Readings :

1. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

Suggested Readings :

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.

E-resource :

https://onlinecourses.nptel.ac.in/noc22_ma03/preview
https://www.youtube.com/watch?v=M0HIUJbn-V4

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Department of Mathematics and Statistics
Dr. Harisingh Gour Vishwavidyalaya, Sagar M.P.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester II (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem II	MTS-DSM-211	Basic Algebra	5	1	0	6	IA(Mid) - 40 EA(End Sem) - 60	Dr. U.K.Khedlekar

Lectures Hrs: 30

Learning Objectives

To explain the construction of integers and properties. The polynomial equations and De Moivre's Theorem

To introduce Basic notions of abstract algebra and related theorems

Course Learning Outcomes: This course will enable the students to

CO1: Employ De Moivre's theorem in a number of applications to solve elementary problems

CO2: To understand the group and its properties

CO3: To understand the cyclic group and its properties

Unit wise Learning Outcomes: After completion of this course successfully, the students will be able to

UO1: Interpret the basic results on division algorithm, Euclidean algorithm and solve elementary problems on them and to learn group forming by roots of polynomial

UO2: To understand the group and subgroup

UO3: Understand about the fundamental concepts of groups, subgroups, normal subgroups, isomorphism theorems, and observe the interesting applications

UO4: Learn about the fundamental concepts of cyclic groups, Classifications of subgroup of cyclic groups, permutation groups and Cayley's theorem

UO4: Learn the fundamental concepts of vector spaces, basis and dimension and to solve elementary problems on them

Unit-I: Sets, Relations, Equivalence relations, Equivalence classes, Finite, countable and uncountable sets, The division algorithm, Divisibility and the Euclidean algorithm, Modular arithmetic and basic properties of congruence, Elementary theorems on the roots of polynomial equations, Imaginary roots. The fundamental theorem of algebra (statement only), The n^{th} roots of unity, De Moivre's theorem for integer and rational indices and its applications
Unit-II: Definition and properties of a group, Abelian groups, Examples of groups including D_n(dihedral groups),Q_8(quarternian group), $GL(n,\mathbb{R})$ (general linear groups) and $SL(n,\mathbb{R})$(special linear groups), $\mathbb{Z}_n, U(n)$, Subgroups and examples.
Unit-III Cosets and their properties, Lagrange's theorem and its applications.
Unit-IV: Cyclic groups and propertie. Normal subgroups and their properties, Simple groups, Factors groups, Group homomorphisms and isomorphisms with properties, First, second and third isomorphism theorems for groups
Unit-V: Classifications of subgroup of cyclic groups, Cauchy theorem for finite Abelian groups, Centralizer, Normalizer, Center of a group, Product of two subgroups, Permutation group and properties, Even and odd permutations, Cayley's theorem

Essential Readings:

1. Michael Artin (2014). Algebra (2nd edition). Pearson
2. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson
3. Stephen H. Friedberg, Arnold J Insel& Lawrence E. Spence (2003). Linear Algebra (4th edition) Prentice-Hall of India Pvt. Ltd

Suggested Readings:

1. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage
2. Kenneth Hoffman& Ray Kunze (2015). Linear Algebra (2nd edition). Prentice-Hall
3. I. N. Herstein (2006). Topics in Algebra (2nd edition) Wiley India
4. Nathan Jacobson (2009). Basic Algebra I (2nd edition) Dover Publications

E- Resource :

1. https://nptel.ac.in/courses/106104149
2. https://nptel.ac.in/courses/111102011
3. https://nptel.ac.in/courses/111108098
   Modern Algebra | Mathematics - MIT OpenCourseWare

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester II (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem II	MTS-MDM-211	Numerical Methods	4	2	0	6	IA (Mid)-40 EA (End Sem)- 60	Dr. R.K.Pandey

Lectures Hrs: 90

Learning Objectives

1. To explain the construction of numerical method for the solution of algebraic and transcendental equations.
2. To introduce convergence and stability criteria for various numerical method.
3. To explain the numerical methods for solution of system of linear and nonlinear equations.
4. To explain the relaxation and iterative methods.
5. To explain the concept of interpolation, Lagrange and Newton's interpolation.

Course Learning Outcomes: This course will enable the students to:

CO-1 Obtain numerical solutions of algebraic and transcendental equations.

CO-2 Find numerical solutions of system of linear equations and to check the accuracy of the solutions.

CO-3 Learn about various interpolating methods to find numerical solutions initial value problems in differential equations

Unit wise Learning Outcomes: After completion of this course students will be able to:

UO1: Obtain the approximate solution of algebraic and transcendental equations.

UO2: Know the alternative numerical method to find the solutions of system of linear equations and able to know the way to check the accuracy of the solutions.

UO3: Interpret the interpolation to find the missing value form the given set of points. They should also know the concept of finite difference.

UO4: Know the derivation of trapezoidal and Simpson's rule and capable to evaluate the integrals numerically using these methods.

UO5: Understand application of various numerical methods to find the solution of differential equations.

Unit-I: Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence, Intermediate value theorem and Fixed point theorem (without proof). Bisection method, method of false position, fixed point iteration method.
Unit-II: Newton Raphson and secant method for solving equations. Partial and scaled partial pivoting, LU decomposition and its applications, Gauss Elimination, Gauss Jordan method, Indirect method: Jacobi and Gauss-Seidel methods.
Unit-III: Finite differences; Interpolation; Newton's forward and backward interpolation, Lagrange's interpolation, Newton's divided difference; Piecewise interpolation, Spline.
Unit-IV: First order and second order approximation for first derivative, Approximation for second derivative, Numerical integration: Trapezoidal rule, Simpson's rule and error, Gauss Quadrature.
Unit-V: Picard method, Euler's method (Forward, Backward and Modified), Runge-Kutta methods (explicit), Error term of Euler method.

Essential Readings:

1. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson.
2. M.K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition), New Age International Publishers.
3. Robert J. Schilling & Sandra L. Harris (1999). Applied Numerical Methods for Engineers Using MATLAB and C. Thomson-Brooks/Cole.
4. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Company Inc., New York, 1982

Suggested Readings:

1. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, New Delhi, 2010
2. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India

E- Resource :

Numerical methods - Course (nptel.ac.in)
Introduction to Numerical Methods | Mathematics | MIT OpenCourseWare

12/12/23

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Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester II (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem II	**MTS-AEC - 211**	**Fundamentals of Computer**	**2**	**0**	**0**	**2**	**IA (Mid) – 40 EA (End Sem) - 60**	**Prof. D. Shukla**

Lecture Hrs. 60

Learning Objectives:

- To confidently operate computers to carry out computational tasks
- To understand working of Hardware and Software, the importance of programming languages, number systems.
- To describe the organization and operation of a computer processor, primary and secondary memory, peripheral devices and to give computer specifications

Course Learning Outcomes:

CO 1: Students should enhance knowledge of computer, structure of computer and its generation.
CO 2: Students should be familiar with conversion of number systems.
CO 3: Students should be able to understand the basic concept of programming languages.

Unit wise Learning Outcomes: After the completion of course students should be able

UO 1: To enhance the basic knowledge of computer and its generation.
UO 2: To understand the basic structure and types of computer.
UO 3: To familiar with the number system and conversion from one to another.
UO 4: To understand various types of computer memory.
UO 5: To gain the basic knowledge of computer programming.

Unit I:	Introduction to Computers - Computer Characteristics, Concept of Hardware, Software, Evolution of computer and Generations,
Unit II:	Types of Computer – Analog and Digital computers, Hybrid Computers, General Purpose and Special Purpose Computer, Limitations of Computer, Functional Block Diagram of Computer. CPU, ALU, Memory Unit.
Unit III:	Number Systems – different types, conversion from one number system to another,Input Device – Keyboard, Mouse, Scanner, MICR, OMR. Output Devices – VDU, Printers – Dot Matrix, Daisy-wheel, Inkjet, Laser, Line Printers and Plotters.
Unit IV:	Memory Concept, Memory Cell, Memory Organization, Semiconductor Memory – RAM, ROM, PROM, EPROM, Secondary Storage Devices – Magnetic Tape, Magnetic Disk (Floppy Disk and Hard Disk.), Compact Disk.
Unit V:	Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler.

Essential Readings

1. P.K. Sinha and P. Sinha, Computer Fundamentals, BPB Publishers, 2007.
2. Sheema Thareja, Fundamental of Computers Oxford University Press, 2019.

Suggested Readings

1. E. Balagurusamy, Fundamental of Computers and Programming, McGraw Hill Education 2011.
2. A. Geol, Computer Fundamentals, Pearson Education, 2010.

Essential e-Resources

- https://www.amazon.in/Fundamentals-Computers-Manaullah-Abid-ebook/dp/B07YZ36XHM
- https://www.mheducation.co.in/fundamentals-of-computers-9780070141605-india

DShukla 12/12/23

अध्यक्ष / Chairman
बोर्ड ऑफ स्टडीज (गणित एवं सांख्यिकी)
Board of Studies (Mathematics & Statistics)
गणित एवं सांख्यिकी विभाग
Department of Mathematics and Statistics
डॉ. हरिसिंह गौर विश्वविद्यालय, सागर म.प्र.
Dr. H.S. Gour Vishwavidyalaya, Sagar M.P.

Passed by Board of Studies Dated 12/12/23

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester II (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L5 Sem II	**MTS-SEC-211**	**Boolean Algebra**	**2**	**0**	**0**	**2**	**IA (Mid)-40 EA (End Sem)- 60**	**Dr. Kavita Shrivastava**

Lectures Hrs: 30

Learning Objectives:

1. Students will achieve command of the fundamental definitions and concepts of Boolean Algebra.
2. To explore the concept of logic gates.
3. To explore modern applications of Switching circuits.
4. Able to apply theoretical knowledge acquired to solve realistic problems in real life.

Course Learning Outcomes:

CO1: Understand the basic concepts of Boolean algebra and Boolean functions
CO2: Understand the properties, theorems and be able to prove new theorems.
CO3: Understand the concept of lattice.
CO4: Understand the application of switching circuits.
CO5: Understand the logic gates and its application in real life.

Unit Wise Learning Outcomes:

UO1. To learn about Partial ordered set, Hasse diagrams.
UO2. To learn about lattice.
UO3. To learn about Boolean algebra.
UO4. Aware about Switching circuits.
UO5. Aware about logic getes and its applications.

Unit I: Introduction partial ordered set, well ordered set, Chain, Hasse diagram, Maximal and Minimal elements, Lower and Upper bound, Joint and Meet in poset.
Unit II: Lattice as ordered sets, Complete lattice, Lattice as algebraic structure, Sub lattice, Properties of lattice, semi lattice, Lattice isomorphism, complement of an element, Complemented lattice.
Unit III: Introduction Boolean algebra, General properties of Boolean algebra, Boolean algebra as a lattice, Isomorphic Boolean algebra.
Unit IV : Boolean Expressions, Boolean functions, Switching circuits and its application.
Unit V : Basic logical operations, law of logic, logic gates and its application.

Essential Readings :

1. J.P.Tremblay & R. Manobar, Discrete Mathematical Structures, McGraw Hill, New Delhi.
2. Narsingh Deo, Graph Theory with applications, Prentice-Hall, New Delhi.

Suggested Readings :

1. C.L.Liu, Elements of Discrete Mathematics, McGraw Hill, New Delhi.
2. J.L. Gresting, Mathematical Structures for Computer Science, Computer Science Press, New York.
3. R. L. Goodstein, Boolean Algebra, Dover Publication, Inc. Minola, New York.
4. Steven Givant and Paul Halmos, Introduction to Boolean Algebras, Springer; 2009th edition

E book links: National Digital Library

1. https://www2.southeastern.edu/Academics/Faculty/kyang/2018/Spring/CMPS375/ClassNotes/CMPS375ClassNotesChap03.pdf
2. https://www.hzu.edu.in/csit/Boolean%20Algebra%20%20computer%20fundamentals.pdf
3. https://www.youtube.com/watch?v=gqv2t7YzPRw
4. https://www.youtube.com/watch?v=KergVtV3SxU
5. https://www.youtube.com/watch?v=K73N9ES_8nI
6. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C

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Board of Studies (Mathematics & Statistics)
डॉ. हरिसिंह गौर विश्वविद्यालय, सागर
Dr. Harisingh Gour Vishwavidyalaya, Sagar

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester III (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L 6 Semester III	MTS-DSM-311	Differential Equations	5	1	0	6	IA (Mid)-40 EA (End Sem)- 60	Dr. U.K.Khedlekar

Lectures Hrs. 60

Learning Objectives:

1. To understand the basic concept of differential equations and its uses
2. To be familiar with the application of exact equations and its applications
3. To aware students for the use of differential equations to real life problems

Course Learning Outcomes:

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

CO 1 Awareness about creation of differential equation
CO 2. Learning of several methods for approaching to solution of problems
CO 3 Strong understanding about linear difference equations and their applications

Unit Wise Learning Outcomes:

UO1. Learning of construction of exact differential equation of first order.
UO2: Learning of the concept of linearly dependent and independent differential equations.
UO3: Solution of the differential equation by method of variation of parameter.
UO4: Constructing the partial differential equations
UO5: Classification of the second order partial differential equation and solving by Charpit's method.

Unit-I: First order exact differential equations, integrating factors, rules to find an integrating factor, first order higher degree equations solvable for x, y and p, Methods for solving higher-order differential equations.
Unit-II: Basic theory of linear differential equations, Wronskian and its properties, solving a differential equation by reducing its order, linear homogenous equations with constant coefficients, linear non-homogenous equations.
Unit-III: Method of variation of parameters, Cauchy-Euler equation, simultaneous differential equations, total differential equations.
Unit-IV: Order and degree of partial differential equations, concept of linear and non-linear partial differential equations, formation of first order partial differential equations, linear partial differential equation of first order, Lagrange's method.
Unit-V: Charpit's method, classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Essential Readings:

1. Shepley L. Ross, (1984): *Differential Equations*, 3rd Ed., John Wiley and Sons.
2. Sneddon, (1967): *Elements of Partial Differential Equations*, McGraw-Hill, International Edition.

Suggested Readings

1. Video lecture on ordinary differential equation of first order-Exact differential equation
   Link https://www.youtube.com/watch?v=suvzwN2Df7k
2. Video lecture on Partial Differential Equation - Charpit's Method for Non Linear PDE
   Link https://www.youtube.com/watch?v=2_hfp8JPP30

E-resource:

1. Differential Equations, **Shepley L. Ross,** John Wiley and Sons (WIE),ISBN: 9780471814504, 0471814504
   http://booksdescr.org/item/index.php?md5=1A0161B225BA96E5FC760145FB5F1E7B
2. **Partial Differential Equations, F. John (auth.),** Applied Mathematical Sciences, Springer ISBN: 0387906096, 9780387906096, 3540906096
   http://booksdescr.org/item/index.php?md5=1F0898E6DA3882791DB68EEE5780CACB
3. National Digital Library

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester III (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L6 Semester III	MTS-MDM-311	Mechanics	5	1	0	6	IA (Mid) - 40 EA (End Sem) - 60	Dr. Bhupendra

Lectures Hrs. 60

Learning Objectives:

1 To develop the knowledge of coplanar forces, virtual works
2 To develop applications and solve problems using mechanics.

Course Learning Outcomes:

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

CO1 Understand different kind of forces
CO2 Solve the problems of Catenary and its applications.
CO3 Derive the equations of Poinsot's central axis

Unit Wise Learning Outcomes:

UO1 Learning about coplanar forces.
UO2 Understanding about virtual work and its properties
UO3 Understanding about Catenary and its real life application
UO4 Knowledge about nature of stability.
UO5 Learning about the forces in three dimensions and null lines and planes.

Unit - I: Coplanar forces Analytical conditions of equilibrium of coplanar forces. Theorems on coplanar forces and moment of couple. Lami's theorem.
Unit - II: Virtual work Virtual work. Principle of virtual work for a system of coplanar forces.
Unit - III: Catenaries Geometrical properties of the Catenary, sag of telegraph wires.
Unit - IV: Stable and unstable equilibrium Equilibrium of a heavy body, stable, unstable and neutral equilibrium, test for determining the nature of stability.
Unit - V: Forces in three dimensions. Forces in three dimensions. Poinsot's central axis. Screws and Wrenches, resultant of two given wrench, pitchs. Null lines and planes.

Essential Readings:

1. S. L. Loney. *Statics*, Macmillan & Co , London.
2. M. Ray, R. D. Manglik & G.C. Sharma, (1994): *A Text Book on Statics*, S. Chand & Company Ltd. Ram Nagar, New Delhi-110055.

Suggested Readings :

1. R.S.Verma *A Text book on Statics*, Pothishala Prakashan Pvt. Ltd, Allahabad
2. P.K.Mittal, (2016) *Mathematics for Degree Students*, S. Chand & Company Ltd. (AN ISO 9001: 2008 Company), Ram Nagar, New Delhi-110055

E-resource:

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester III (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L 6 Semester III	MTS-AEC-311	Portfolio Optimization	2	0	0	2	IA (Mid) - 40 EA (End Sem)- 60	Dr. M.K.Yadav

Lectures Hrs. 30

Learning Objectives:

1. To learn various financial markets worldwide.
2. To learn understanding about the designing portfolio.
3. To study the expected risk and return of portfolio.
4. To study portfolio optimization by using mean variance method.
5. To find various measures of portfolio.

Course Learning Outcomes:

After completion of this course the students will be able to:

CO1: Understand investment objectives and outcomes thereon.
CO2: Understand diversification in financial market.
CO3: Understand efficient frontiers and risk existing in financial market.

Unit Wise Learning Outcomes:

UO1: Learning about how to optimize a portfolio.
UO2: Understanding about more than one securities portfolio
UO3: Knowledge about one and two fund theorems.
UO4: Awareness about various measures relating to portfolio.
UO5: Learning about risk and return in various methods of performance evaluation in financial sector.

Unit-I: Financial markets. Investment objectives.
Unit-II: Measures of return and risk. Types of risks. Portfolio of assets.
Unit- III: Expected risk and return of portfolio. Diversification.
Unit-IV: Mean-variance portfolio optimization- Markowitz model and the two-fund theorem, risk free assets and one fund theorem, efficient frontier.
Unit-V: Portfolio performance evaluation measures.

Essential Readings:

1. H.M. Markowitz, (1987): Mean-Variance Analysis in Portfolio Choice and Capital Markets, Blackwell, New York.
2. D.G. Luenberger, (2013): Investment Science, 2nd Ed., Oxford University Press.

Suggested Reading:

1. F.K. Reilly, Keith C. Brown, (2011): Investment Analysis and Portfolio Management, 10thEd., South Western Publishers.

E-Resources: National digital Library

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester IV (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L 6 Semester IV	MTS-DSM-411	Real Analysis- I	5	1	0	6	IA(Mid) –40 EA(End Sem)-60	Dr. R.K.Pandey

Lectures Hrs. 60

Learning Objectives:

1. To explain fundamentals of cardinality of a set and to classify sets on the basis of cardinality.
2. To explain limit point of a set and Bolzano Weierstrass theorem.
3. To introduce the notion of convergence of sequence.
4. To explain the convergences of an infinite series and various tests for convergence and also to introduce the concept of Riemann integration.
5. To explain the convergence of sequence and series of functions applications of uniform convergence in case of sequence/series of continuous, differentiable and Riemann integrable functions.

Course Learning Outcomes: This course will enable the students to:

CO-1: Interpret the order structure of set of real numbers and its properties.
CO-2: Learn limit and sub sequential limits of sequence.
CO-3: Understand the convergence of an infinite series.
CO-4: Learn the notion of Riemann integration.
CO-5: Learn the notion of continuity and differentiability and related important theorems.

Unit wise Learning Outcomes:

UO-1: Developing better intuition to check the cardinality of set.
UO-2: Learning about skills to examine the convergence of a sequence and sub sequential limits.
UO-3: Learning about the skills to find the limit sequences using the Cauchy theorem.
UO-4: Understanding the skills to test the convergence of series with nonnegative terms.
UO-5: Awaring about the concepts of uniform and point wise convergence and its consequences in preservation of limit, continuity, integration etc.

Unit-I: Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, supremum and infimum, completeness property of R, Archimedean property of R, intervals, Interior points and limit points, open, closed, and perfect sets. Statement of Bolzano-Weierstrass theorem, compact sets.
Unit-II: Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits, Order preservation and squeeze theorem. Subsequence, limsup and liminf and convergence criterion using them. Monotone sequences and their convergence (monotone convergence theorem without proof).
Unit-III: Infinite series and their convergence, geometric series. Cauchy criterion, comparison test. Series of non-negative terms, convergence of p-series. Cauchy's condensation test, integral test, ratio and root tests (Tests of convergence without proof).
Unit-IV: Absolute and conditional convergence, alternating series, and Leibnitz's theorem. Riemann integration, necessary and sufficient condition of Riemann integration, algebra of Riemann integrable functions, fundamental theorem of integral calculus.
Unit-V: Sequences and series of functions, point-wise and uniform convergence, Mn-test, Weiertrass M-test, Statements of the results and applications on uniform convergence and continuity, uniform convergence and integration and differentiability of functions, Power series and radius of convergence.

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Essential Readings:

1. R G Bartle and D R Sherbert, (2000). *Introduction to Real Analysis*. John Wiley and Sons (Asia) P. Ltd
2. T M Agrawal, (1985). Mathematical analysis. Narosa

Suggested Readings:

1. Walter Rudin. Principles of Mathematical Analysis, McGraw Hill
2. Terence Tao, (2014). Analysis I, Hindustan Book Agency (third edition)
3. Terence Tao, (2011). Analysis II, Springer and Hindustan Book Agency (third edition)

E-Resources:

4. https://nptel.ac.in/courses/111106053
5. https://nptel.ac.in/courses/111105058
6. https://ocw.mit.edu/courses/18-100a-real-analysis-fall-2020/#:~:text=Course%20Description,the%20interchange%20of%20limit%20operations.
7. National Digital Library

Chairman

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester IV (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L 6 Semester IV	MTS-MDM-411	Metric Space	5	1	0	6	IA (Mid) - 40 EA (End Sem)- 60	Dr. Kavita Shrivastava

Lectures Hrs. 60

Learning Objectives:

1. To study besic definition of Metric spaces.
2. To understand basics of Topology.
3. To examine the convergence of sequence in Metric spaces.
4. To differenciate in continuity and uniform continuity.
5. To study connectedness and compactness in Metric space.

Course Learning outcomes:

After completion of this course the students will be able to:

CO1: Understand the basic concept of metric space.
CO2: Correlate these concepts to their counter parts in real analysis.
CO3: Aware about the abstractness of the concepts such as open balls, closed balls, compactness, connectedness beyond their geometrical imaginations.

Unit Wise Learning Outcomes:

UO 1: Understanding to the definition of Metric space.
UO 2: Learning about the concept of open sets and closed sets.
UO 3: Awareness of the concept of convergence.
UO 4: Understand the concept of limit and continuity, Banach Fixed point theorem.
UO 5: Knowledge about continuous functions on compact spaces.

Unit 1: Metric spaces: Definition and examples of metric spaces, diameter and boundedness, subspace.
Unit II: Open and closed ball, neighbourhood, open set, interior of a set, limit point of a set, derived set, closed set, closure of a set, Cantor's theorem, dense set.
Unit III: Convergence and completeness- convergence of sequence, Cauchy sequence, completeness
Unit IV: Limit and continuity, uniform continuity, contraction mapping, Banach fixed point theorem.
Unit V: Basics of connectedness, connectedness and continuity, compactness and boundedness, continuous functions on compact spaces.

Essential Readings:

1. Kumaresan, S. (2014). Topology of Metric Spaces, (2nd ed.). Narosa Publishing House.
2. Simmons, G. F. (2004). Introduction to Topology and Modern Analysis. Tata McGraw Hill.

Suggested Readings:

1. Dugundji, J., Topology, Allyn and Bacon Series in Advanced Mathematics, Allyn & Bacon.
2. Munkres, J.R., Topology (2nd Edition), Prentice-Hall
3. Shirali, Satish & Vasudeva, H. L. (2009). Metric Spaces, Springer, First Indian print.

E-Resources

1. Link-NPTEL – Mathematics - Topology
2. https://nptel.ac.in/courses/111101158
3. National Digital Library

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Passed by Board of Studies Dated. 12/12/23 Passed by School Board Dated. 13/12/23

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
Syllabus as per NEP-2020
B.A./ B.Sc.- Semester IV (Mathematics)

Level & Semester	Course Code	Title of Course	Credits				Marks	Course Designer
			L	T	P	C		
L6 Semester IV	MTS-SEC-411	Tautology	2	0	0	2	IA (Mid)-40 EA (End Sem)- 60	Dr. Bhupendra

Lectures Hrs. 30

Learning Objectives:

1. To develop the knowledge of logical connectives and tautology.
2. To discuss applications of Tautology among student.
3. To develop capability for reaching to ultimate logical conclusions.

Course Learning Outcomes:

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

CO1: Have an understanding about the different kinds of logical sentences.

CO2: Have intense knowledge about to prepare truth tables.

CO3: Have understanding about comparison of different kinds of logical equivalences.

Unit Wise Learning Outcomes:

UO1: Learning about logic and sentence.

UO2: Understanding about basic logical operations and ability to solve the examples.

UO3: Knowledge of tautology and contradiction.

UO4: Learning about different types of logical equivalence laws.

UO5: Awareness about normal or canonical form.

Unit - I: Introduction of logic, logical connectives, kinds of sentences, truth value of a statement and its examples.
Unit - II: Truth tables, basic logical operations and its applications.
Unit - III: Tautology and Contradiction of statements with examples.
Unit - IV: Logical equivalence, Algebra of propositions: Distributive laws, De-Morgan's laws.
Unit - V: Normal or Canonical forms, Disjunctive normal form and Conjunctive normal form, and its applications.

Essential Readings:

1. C. L. Liu, (1985): *Elements of Discrete Mathematics*, McGraw Hill, New Delhi

Suggested Readings :

1. J.P. Tremblay & R. Manobar, (1997): *Discrete Mathematical Structures*, McGraw Hill, New Delhi.
2. D.C. Agrawal, (2012): *Discrete Structrue*, Shree Sai Prakashan, Meerut.

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