



ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B. Tech. Scheme of Examination & Syllabus 2025-26 Computer Science and Engineering (DATA SCIENCE)

SEMESTER II

Sr No	Course Category	CourseCode	Course Title	Hours per Week			Credits	Maximum Marks				Minimum Passing Marks	Duration of ESE
				L	T	P		Mid-Sem Examination	Continual Assessment	End Sem Examination	Total		
1.	BSC	25DS201T	Engineering Physics and Materials Science	2	-	-	2	10	10	30	50	23	1.5
2.	BSC	25DS201P	Engineering Physics and Materials Science Lab	-	-	2	1	-	25	25	50	25	-
3.	BSC	25DS202T	Statistics and Probability	3	-	-	3	20	20	60	100	45	3
4.	BSC	25DS202P	Statistics and Probability Lab	-	-	2	1	-	25	25	50	25	-
5.	ESC	25DS203T	Data Structures	3	-	-	3	20	20	60	100	45	3
6.	ESC	25DS203P	Data Structures Lab	-	-	2	1	-	25	25	50	25	-
7.	ESC	25DS204T	Introduction to Data Science	2	-	-	2	10	10	30	50	23	1.5
8.	PCC	25DS205P	Data Science workshop – II	-	-	4	2	-	25	25	50	25	-
9.	AEC	25DS206P	Business Communication Skills – II Lab	-	-	2	1	-	25	25	50	25	-
10.	SEC	25DS207T	Design Thinking #	2	-	-	2	10	10	30	50	23	1.5
11.	CC	25DS208P	Co-curricular Courses – II	-	-	4	2	-	50	-	50	25	-
Total				12	0	16	20	70	245	335	650	-	-

To be conducted online through NPTEL

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SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
25DS201T	Engineering Physics and Materials Science	2	--	--	2	10	10	30	50

Course Objectives	Course Outcomes
This course is intended 1. To understand the basic laws of physics and their application in engineering and technology. 2. To develop scientific temper and analytical capability.	Students will be able to 1 Explain the fundamental concepts of solid-state physics including free electron theory, band formation, semiconductors, magnetic materials, and their applications in electronic and storage devices. 2 Analyze the principles of optical communication by understanding light propagation in optical fibers, numerical aperture, modes of propagation, fiber losses, and fiber optic sensors. 3 Apply the concepts of quantum physics such as wave-particle duality, de Broglie hypothesis, uncertainty principle, and wave function to physical systems. 4 Evaluate the role of semiconductors, magnetic materials, optical fibers, and quantum mechanics in modern technologies, including communication systems, storage devices, and quantum computing applications.

Unit I BASICS OF SOLID-STATE PHYSICS [11 Hrs]

Semiconductors: Free electron Theory (qualitative idea) and its features; Idea of band formation in solids, Classification of solids: Metal, Insulator, Semiconductor; Fermi Energy, Types - Intrinsic and Extrinsic Semiconductors, Applications of solid state devices - p-n junction diode and transistor.

Magnetic materials: Terms and definitions, Types of magnetic materials, characteristics of Diamagnetic, Paramagnetic and Ferromagnetic Materials, Applications of soft and hard magnetic materials with a special emphasis on storage devices such as hard disk, floppy disk and magnetic tapes, advantages & disadvantages.

Unit II OPTICAL COMMUNICATION [11 Hrs]

Introduction, Optical Fiber, Total Internal Reflection, Propagation of light through an Optical Fiber, Fractional Refractive Index Change, Numerical Aperture, Modes of Propagation, Classification of Optical Fibers, The Three types of fibers, Comparative characteristics, V-Number, Losses in Optical Fiber, Fiber Optic Communication System, Merits of Optical Fibers, Fiber Optic Sensors (Temperature sensor and Liquid Level detector)

Unit III QUANTUM PHYSICS [08 Hrs]

Dual nature, de-Broglie hypothesis, Wave packet, phase and group velocity, Uncertainty principle - physical significance and its application, Wave function - probability and normalization, Brief idea of application of quantum mechanics in quantum computing.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Physics	David Halliday, Robert Resnick and Jerle Walker	8e extended	John-Wiley India
2	Electronic Engineering Materials and Devices	John Allision	10 th edition reprint	TMH
3	Engineering Physics	M. N. Avadhanulu	Latest edition	S. Chand & Co.

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Solid State Physics	Charles Kittel	Eighth edition	John Wiley & Sons, Inc
2	Optical Fiber Communication - Principles & Practice	John M. Senior	3 rd Edition	Prentice Hall
3	Quantum Mechanics	Schiff	First Edition	McGraw-Hill Book Company, Inc.

Online Resources

1	https://www.britannica.com/science/semiconductor#ref233890
2	https://www.geeksforgeeks.org/semiconductors/
3	https://www.sciencedirect.com/topics/chemistry/magnetic-material
4	https://www.livescience.com/33816-quantum-mechanics-explanation.html

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25DS201P	Engineering Physics and Materials Science Lab	--	--	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended 1. To understand the basic laws of physics and their application in engineering and technology. 2. To develop scientific temper and analytical capability.	Students will be able to 1. Verify principles/ laws by selecting and using proper measuring instruments, interpret result and draw conclusions. 2. Find various parameters using various properties of light. Apply the concepts of Semiconductors and Quantum Mechanics.

Expt. No.	Title of the experiment
1	Study of semiconductor diodes
2	Study of Phenomenon of Diffraction
3	Study of Interference
4	Study of Birefringence
5	Determination of Numerical Aperture (NA) of given Optical Fiber
6	Determination of Planck's Constant using LED
7	Guoy's Balance Method a) Determination of Magnetic Susceptibility of different magnetic materials. b) Identification of different types of Magnetic Materials
8	Study of Planck's Constant by means of LED
9	Determination of Curie Temperature of Ferromagnetic Material.
10	Study of Transistors.
11	Study of Hall Effect.
12	Experiment on 'Quantum Eraser'.
13	Demonstration of phenomena of Optics using Laser.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Physics	David Halliday, Robert Resnick and Jerle Walker	8e extended	John-Wiley India
2	A Textbook of Engineering Physics	Dr. M. N. Avdhanulu, Dr. P. G. Kshirsagar	Latest edition	S. Chand Publication.
3	Principles of Physics	David Halliday, Robert Resnick, Jearl Walker	10th Edition	John Wiley and Sons (2017)

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Solid State Physics	Charles Kittel	Eighth edition	John Wiley & Sons, Inc
2	Solid State Physics	R.L. Singhal	Eighth edition	Kedarnath Ramnath
3	University Physics	Young and Freedman	Fifteenth edition	Pearson Education

Online Resources

1	https://www.britannica.com/science/semiconductor#ref233890
2	https://www.geeksforgeeks.org/semiconductors/
3	https://www.sciencedirect.com/topics/chemistry/magnetic-material

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
25DS202T	Statistics and Probability	3	-	-	3	20	20	60	100

Course Objectives	Course Outcomes
<p>This Course is intended to</p> <ol style="list-style-type: none"> To equip students with the skills to analyze, interpret, and model statistical data using appropriate computational and analytical techniques. To equip learners with the skills to analyze random phenomena, compute expectations, and interpret results using probability distributions. 	<p>Students will be able to</p> <ol style="list-style-type: none"> Solve numerical integration and find analytical solutions to difference equations. Apply statistical methods such as regression, correlation, and least squares fitting to analyze data. Apply probability theory and expectations to analyze data and solve engineering problems. Apply probability distributions to model and interpret random phenomena.

Unit I	[9hrs]
Finite Differences: Operator E and delta, Factorial Polynomial, Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Difference equations with constant coefficients.	
Unit II	[9hrs]
Statistics: Fitting of straight line, parabola and exponential curves by method of least squares, Coefficient of correlation and lines of regressions, Rank correlation, Multiple regression.	
Unit III	[9hrs]
Probability: Random Variable: Discrete & Continuous random Variable, Probability function, Distribution function, Baye's rule, Mathematical expectations, Variance and Standard deviation.	
Unit IV	[9hrs]
Joint probability: Joint probability function of discrete random variable, Marginal probability function and Conditional distribution of discrete random variable, Mathematical expectation of discrete random variable, Variance and Standard deviation, and Covariance of joint distribution.	
Unit V	[9hrs]
Probability Distributions: Binomial Distribution, Poisson's Distribution, Normal Distribution.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Higher Engineering Mathematics	B. S. Grewal	40 th	Khanna Publishers, New Delhi.
2	Higher Engineering Mathematics	H. K. Dass and Er. Rajnish Verma	1st	S. Chand & Co. Pvt. Ltd., New Delhi.

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Higher Engineering Mathematics	B. V. Ramana	11th	Tata McGraw-Hill Publication
2	A Text Book of Engineering Mathematics	Peter O' Neil	8th	Thomson Asia Pvt. Ltd., Singapore.

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25DS202P	Statistics and Probability Lab	--	--	2	1	25	25	50

Course Objectives	Course Outcomes
<p>This Course is intended to:</p> <ol style="list-style-type: none"> To develop students' ability to analyze and interpret statistical data using SageMath. To enable students to model, simulate, and interpret probability distributions and compute associated measures using SageMath's computational tools. 	<p>Students will be able to:</p> <ol style="list-style-type: none"> Apply symbolic and numerical computation techniques using SageMath to solve problems in calculus and discrete mathematics. Analyze and interpret mathematical models using data fitting, correlation, and regression techniques. Evaluate and interpret statistical parameters for joint and marginal probability distributions using SageMath. Model, compute, and visualize discrete probability distributions using SageMath tools.

List of Experiments:-

Experiment No.	List of Experiment
1	To compute factorial polynomials for a given algebraic function with the help of SageMath.
2	To evaluate definite integrals by employing SageMath using Numerical Techniques.
3	To fit linear and quadratic models by means of the SageMath environment using least squares method.
4	To calculate the correlation coefficient and derive regression lines through the use of SageMath tools.
5	To determine Spearman's rank correlation coefficient with the help of SageMath.
6	To evaluate statistical parameters of a given probability distribution with the help of SageMath.
7	To construct and interpret joint and marginal distributions Using SageMath functionality.
8	To model and visualize the Poisson distribution executed through SageMath.
9	To compute and plot the Binomial distribution within the SageMath platform.
10	To analyze the Normal distribution using SageMath's statistical and graphical tools.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Computational Mathematics with SageMath	Paul Zimmermann	1st	SIAM Publications Library.
2	Basics of SageMath : Mathematics(Practicals)	Varun Kumar	1st	Amazon KDP

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Mathematics-SageMath Math Software System	Indrajeet Varhadpande & Dr. Kirti Sahu	1 st	Himalaya Publication
2	Applied Mathematics Using SageMath	Dr. Kirti Sahu and Dr. Sajid Anwar	1 st	Himalaya Publication

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
25DS203T	Data Structures	3	-	-	3	20	20	60	100

Course Objectives	Course Outcomes
<p>This course is intended</p> <ol style="list-style-type: none"> To introduce fundamental data structures and develop the ability to analyze algorithmic efficiency using time and space complexity measures. To enable learners to design and implement linear and nonlinear data structures such as linked lists, stacks, queues, trees, and graphs for solving computational problems. To equip students with problem-solving skills by applying appropriate data structures and algorithms for searching, sorting, traversal, and real-world applications. 	<p>Students will be able to</p> <ol style="list-style-type: none"> Apply appropriate searching and sorting techniques to solve computational problems. Construct various linked list structures and implement various operations and its application. Develop stack and queue implementations using arrays and linked lists. Design tree structures and perform traversal and search operations. Apply suitable graph representations and evaluate graph algorithms.

Unit I	[9Hrs]
Introduction: - Concept of Data structures, Time and space analysis of algorithms, Big oh and theta notations and omega notations, Average, best- and worst-case analysis Searching and sorting techniques- Linear search, Binary search, Indexed search, Insertion sort, selection sort, Bubble Sort, radix Sort, Merge Sort, Quick Sort.	
Unit II	[9Hrs]
Linked Lists: Singly linked list, Implementation of linked list using static and dynamic memory allocation, operations on linked list, polynomial representations and manipulations using linked list, circular linked list, doubly linked list, Generalized list, sparse matrix.	
Unit III	[9Hrs]
Stack and Queue - Array representation of stacks, Implementation of stack using linked lists, Queues, Dequeue, Circular queue, Polish notation, Application of stack & queue: Conversion from Infix to Postfix, Evaluation of postfix expressions, Priority Queues.	
Unit IV	[9Hrs]
Trees: Basic Terminology, Basic trees, Binary tree representations, threaded storage representation, binary tree traversals, binary search trees, Application of trees. Preliminary treatment of AVL Trees, B- Trees.	
Unit V	[9Hrs]
Graphs: Definition & terminology, Graph representation: matrix representation of Graph, List of structure, other representation of graphs, Breadth First Search, Depth First Search, Spanning trees, shortest path algorithm, topological sorting.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Data Structure	Horowitz and Sahani	3	CBS Publications
2	Data Structures	Tanenbaum	4	C Pearson
3	Data structure and Algorithm	Lafore	3	BPB Publication

Reference Books

S. N	Title	Authors	Edition	Publisher
1.	Data Structure and Programme Design in C	Kruse, Leung and Tondo	3	PHI
2.	Schaum's outline: Date Structures	Seymour Lipschutz	2	Tata Mc Graw Hill

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25DS203P	Data Structures Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ol style="list-style-type: none"> To provide knowledge of basic concepts in data structures and algorithms. To emphasize the application of data structures in developing and implementing efficient programs and algorithms. To understand the construct and analysis various data structures and abstract data types. 	<p>Students will be able to</p> <ol style="list-style-type: none"> Implement the basic data structures and implement sorting and searching algorithm Implement linked lists and sparse matrix representation using linked lists. Demonstrate the use of different data structures like stack, queue, postfix expressions using stack-based algorithms. Create binary trees, binary search trees, tree traversals, and explore advanced tree structures. Apply algorithms for graph and implement symbol tables using hash and tree structures.

Expt . No.	Title of the experiment
1	To design and implement basic C program using arrays & structures.
2	To implement a Menu driven program for linear & Binary search methods and demonstrate their constraints.
3	To implement a program sorting and analyze their performances.
4	To implement a Program to apply the concepts of linked list.
5	To implement a Program to demonstrate the working of a Queue.
6	To implement a Program to demonstrate the working of a stack.
7	To implement a Program to demonstrate the working of a tree.
8	To implement a Program to demonstrate the working of a graph.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Data Structure	Horowitz and Sahani	3	CBS Publications
2	Data Structures	Tanenbaum	2	C Pearson Education
3	Data structure and Algorithm	Lafore	3	BPB Publication

Reference Books

S. N	Title	Authors	Edition	Publisher
1	Data Structure and Programme Design in C	Kruse, Leung and Tondo	2	PHI
2	Schaum's outline: Date Structures	Seymour Lipschutz	3	Tata Mc Graw Hill
1.	An Introduction to DS with applications	Trembley and sorenson	2	Mc Graw Hill

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
25DS204T	Introduction to Data Science	2	-	-	2	10	10	30	50

Course Objectives	Course Outcomes
<p>This course aims to provide students will</p> <ol style="list-style-type: none"> Understand fundamental Data Science concepts, including evolution, roles, applications, data security, and data pre-processing methods. Apply exploratory data analytics and model-building techniques for analysis, prediction, and decision-making. Analyze and Evaluate models using validation methods, handle overfitting and underfitting, and optimize model performance using grid search. 	<p>Student will be able to</p> <ol style="list-style-type: none"> Demonstrate an understanding of basic Data Science concepts, including data collection methods and pre-processing techniques. Apply appropriate data analysis and modeling techniques to analyze datasets and develop suitable data models. Evaluate the performance of data models using appropriate validation and evaluation metrics.

Unit I	[10Hrs]
Introduction: Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project Applications of Data Science in various fields – Data Security Issues. Data Collection and Data Pre-Processing: Data Collection Strategies, Data Pre-Processing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.	
Unit II	[10Hrs]
Exploratory Data Analytics -Descriptive Statistics (Mean, Standard Deviation, Skewness, Kurtosis), Box Plot, Pivot Table, Heat Map, Correlation Statistics, ANOVA, Model Building for Association Analysis, Recommendation Systems, Time Series Analysis, Text Analysis, In-sample Evaluation Measures, Prediction, Decision Making.	
Unit III	[10Hrs]
Generalization Error – Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Testing Multiple Parameters by using Grid Search.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Smarter Decisions : The Intersection of IoT and Data Science	Jojo Moolayil	1st	PACKT
2	Doing Data Science	Cathy O'Neil, Rachel Schutt	1st	O'Reilly

Reference Books

S. N	Title	Authors	Edition	Publisher
1.	Practical Data Science with R	Nina Zumel, John Mount.	2nd	Manning
2.	Data Science for business	F. Provost, T Fawcett	1st	

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25DS205P	Data Science Workshop – II	-	-	4	2	25	25	50

Course Objectives	Course Outcomes
<p>This course is intended</p> <ol style="list-style-type: none">To develop a strong foundation in mathematical and programming concepts.To enable students to understand and implement fundamental data structuresTo train students in data manipulation and preprocessing techniquesTo equip students with the ability to perform statistical analysis and data visualization	<p>Students will be able to</p> <ol style="list-style-type: none">Apply fundamental mathematical concepts such as numbers, arrays, matrices, vectors, and factors to solve basic data science problems.Implement single-dimensional and multi-dimensional arrays and perform numerical operations.Analyze and manipulate structured data using Pandas Series and Data Frames for real-time datasets.Perform data preprocessing, basic statistical analysis, and visualization techniques to interpret and present insights from real-world datasets.

Expt. No.	Title of the experiment
1	Study and implement matrices, arrays, factors, and vectors.
2	Study of various data structures required for the data science tools.
3	To implement single and multidimensional arrays and frames using NumPy library.
4	To implement the concept of data manipulation using series and data frames with pandas library.
5	To perform data processing on real time dataset
6	To implement the statistical functions required for data science applications.
7	To perform the data visualization on real time dataset.
8	To perform the data preprocessing on the real time dataset.

Text Books

S.N	Title	Authors	Edition	Publisher
1	R for Data Science	Hadley Wickham and Ganett Gorlemund	1st Edition	O'Reilly
2	The Art of R Programming-A Tour of Statistical Software Design	Norman Matlott	1st Edition	No Starch Press

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25DS206P	Business Communication Skills – II Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
To empower students to develop a career oriented mindset while harnessing the power of LSRW skills.	Students would be able to: 1. Participate in Group Discussions. 2. Improve their reading and formal writing skills. 3. Develop upon their listening skills to engage in meaningful conversations. 4. Develop oratory skills to engage and inform audiences. 5. Prepare themselves for participating in business meetings.

Expt. No.	Title of the experiment
1	Group Discussion
2	Reading for Competitive Exams II
3	Listening Skills II
4	Presenting a TED Talk
5	Media Interaction
6	Business Correspondence II
7	Report Writing
8	Mock Meeting

Reference Books

S. N	Title	Authors	Edition	Publisher
1.	Communication Skills for Engineers	C. Muralikrishna & Sunita Mishra	2nd Edition, 2011	Pearson India Education Services
2.	Communication Skills	Dr. L. Bisen, Dr. B. Agrawal & Dr. N. T. Kalyani	1st Edition, 2021	Himalaya Publishing House
3.	Barron's IELTS Superpack	Lin Lougheed	2012	Barrons Educational Series

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SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
25DS207T	Design Thinking	2	-	-	2	10	10	30	50

Course Objectives	Course Outcomes
<ol style="list-style-type: none">Learn design thinking concepts and principlesUse design thinking methods in every stage of the problemLearn the different phases of design thinkingApply various methods in design thinking to different problems	<ol style="list-style-type: none">Define key concepts of design thinkingPractice design thinking in all stages of problem solvingApply design thinking approach to real world problems

Unit I **[10 Hrs]**

INTRODUCTION: Why Design? - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.
UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM: Search field determination - Problem clarification - Understanding of the problem - Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

Unit II **[10 Hrs]**

IDEATION AND PROTOTYPING: Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

Unit III **[10 Hrs]**

TESTING AND IMPLEMENTATION: Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.
FUTURE: Design Thinking meets the corporation - The New Social Contract - Design Activism - Designing tomorrow.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Handbook of Design Thinking - Tips & Tools for how to design thinking	Christian Mueller-Roterberg	2021	Independently Published
2.	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	2019	HarperCollins

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Design Thinking for Strategic Innovation	Idris Mootee		Wiley

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