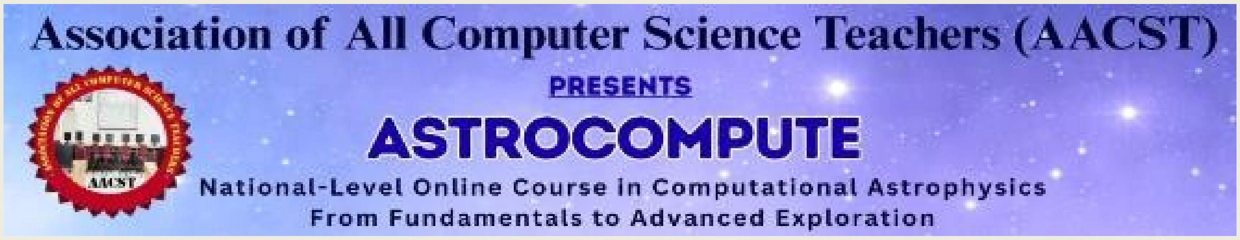


REPORT ON

NATIONAL LEVEL ONLINE COURSE

AstroCompute

National-Level Online Course in Computational Astrophysics
From Fundamentals to Advanced Exploration

21st April to 22nd May 2026

ORGANIZED BY

Association of All Computer Science Teachers (AACST)

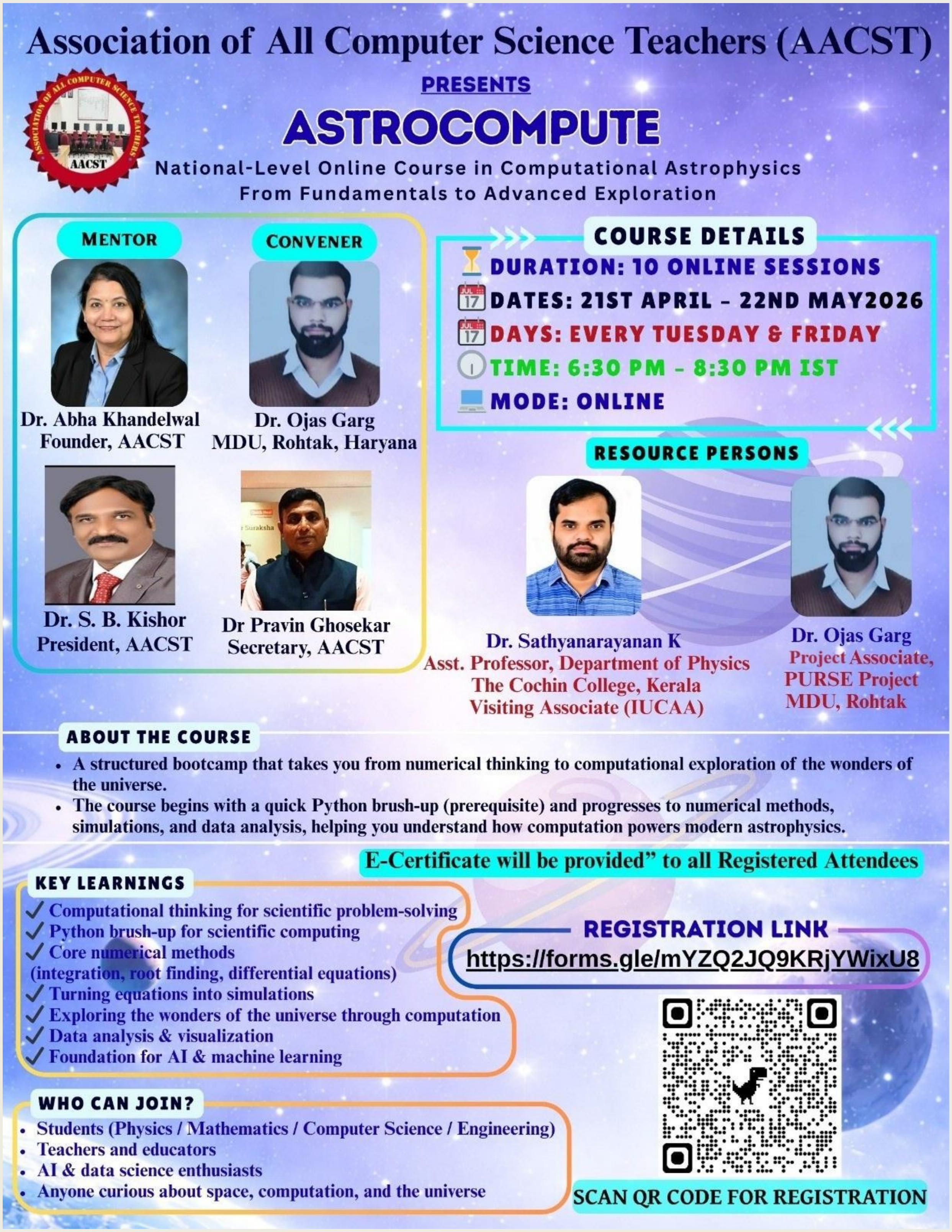
Workshop Patron & Mentor

Dr. Abha Khandelwal, Founder AACST

Workshop Convenor

Dr. Ojas Garg

Project Associate, PURSE Project MDU, Rohtak


Association of All Computer Science Teachers (AACST)
PRESENTS
ASTROCOMPUTE
National-Level Online Course in Computational Astrophysics
From Fundamentals to Advanced Exploration
MENTOR
Dr. Abha Khandelwal
Founder, AACST
CONVENER
Dr. Ojas Garg
MDU, Rohtak, Haryana
Dr. S. B. Kishor
President, AACST
Dr Pravin Ghosekar
Secretary, AACST
COURSE DETAILS
DURATION: 10 ONLINE SESSIONS
DATES: 21ST APRIL – 22ND MAY2026
DAYS: EVERY TUESDAY & FRIDAY
TIME: 6:30 PM – 8:30 PM IST
MODE: ONLINE
RESOURCE PERSONS
Dr. Sathyanarayanan K
Asst. Professor, Department of Physics
The Cochin College, Kerala
Visiting Associate (IUCAA)
Dr. Ojas Garg
Project Associate,
PURSE Project
MDU, Rohtak
ABOUT THE COURSE
• A structured bootcamp that takes you from numerical thinking to computational exploration of the wonders of the universe.
• The course begins with a quick Python brush-up (prerequisite) and progresses to numerical methods, simulations, and data analysis, helping you understand how computation powers modern astrophysics.
E-Certificate will be provided" to all Registered Attendees
KEY LEARNINGS
✓ Computational thinking for scientific problem-solving
✓ Python brush-up for scientific computing
✓ Core numerical methods
(integration, root finding, differential equations)
✓ Turning equations into simulations
✓ Exploring the wonders of the universe through computation
✓ Data analysis & visualization
✓ Foundation for AI & machine learning
REGISTRATION LINK
https://forms.gle/mYZQ2JQ9KRjYWixU8
WHO CAN JOIN?
• Students (Physics / Mathematics / Computer Science / Engineering)
• Teachers and educators
• AI & data science enthusiasts
• Anyone curious about space, computation, and the universe
SCAN QR CODE FOR REGISTRATION

EVENT OVERVIEW:

The **ASTROCOMPUTE Course** was conducted as a structured, concept-driven national-level program from **21st April 2026 to 22nd May 2026**, held daily from **6:30 PM to 8:30 PM**. The bootcamp was designed to guide participants from foundational numerical thinking to computational exploration of the universe.

The program began with a prerequisite **Python brush-up**, ensuring that all learners shared a common computational base. It then progressed through **numerical methods, scientific simulations, and astrophysical data analysis**, helping participants understand how computation powered modern astrophysics.

The bootcamp successfully bridged the gap between **conceptual understanding and real computational application**, enabling learners to transition from classroom knowledge to research-oriented, industry-relevant computational skills. Through its structured modules, ASTROCOMPUTE empowered participants to experience how computation unlocks the mysteries of the cosmos.

NUMBER OF PARTICIPANTS: 32

TARGET AUDIENCE: UG and PG Students, Faculty Members

PATRON & MENTOR: Dr. Abha Khandelwal, Founder AACST

PRESIDENT: Dr. S.B. Kishor, AACST

SECRETARY: Dr.Pravin Ghosekar, AACST

WORKSHOP CONVENER: Dr.Ojas Garg

RESOURCE PERSONS:

1. Dr. Satyanarayanan K,Asst. Professor, Department of Physics,The Cochin College, Kerala Visting Associate(IUCAA)
2. Dr.Ojas Garg (Project Associate,Purse Project,M.D.U.,Rohtak)

COURSE CONTENTS:

SESSION 1 – Why Numerical Physics? (Foundations & Big Picture)

• Meaning of Numerical Physics vs Analytical Physics • Why simulations are essential in modern science (weather, galaxies, black holes) • Real astrophysical problems that cannot be solved analytically • Introduction to numerical errors: truncation vs rounding • Demonstration of a simple physical system solved numerically (free fall / projectile motion)

Outcome: Participants understood why numerical methods are necessary in astrophysics.

SESSION 2– Python Essentials for Scientific Computing

- Python basics for scientific work (variables, loops, functions) • Concept of arrays and vectorized operations (NumPy mindset) • Visualization mindset using plotting libraries • Writing clean, readable scientific code

Activity: • Plotting motion of an object • Running a simple time-evolution simulation

Outcome: Participants gained comfort using Python as a scientific computing tool.

SESSION 3 – Core Numerical Methods (Conceptual Understanding)

- Root-finding methods: Bisection, Newton's Method (intuitive approach) • Numerical differentiation and integration • Discretization: converting continuous physics into computable steps

Demo: • Finding roots of physical equations • Computing area under a curve as a physical quantity

Outcome: Participants learned how mathematical concepts become computable algorithms.

SESSION 4 – Enter Astrophysics + Data Thinking

- Types of data used in astronomy: light curves, spectra, simulation outputs • Visualizing astronomical data • Understanding patterns in astrophysical datasets • How numerical methods form the base of AI/ML in astrophysics

Activity: • Plotting sample astronomical data • Identifying patterns visually

Outcome: Participants connected numerical physics with astrophysics and data science.

SESSION 5 – Solving Equations Numerically (Hands-On)

- Implementing bisection and Newton methods in Python • Applying numerical solvers to astrophysical equations (orbital mechanics, escape velocity)

Coding Task: • Solve a nonlinear equation from astrophysics

Outcome: Participants applied numerical solvers to real scientific problems.

SESSION 6 – Numerical Integration in Physics

- Trapezoidal and Simpson's methods • Applications in physics: – Area under curves –Energy calculations – Flux and luminosity concepts

Coding Task: • Compute physical quantities numerically

Outcome: Participants learned to compute astrophysical quantities using integration.

SESSION 7 – Differential Equations: The Heart of Physics

- Euler method and introduction to Runge–Kutta (RK) methods • Physical systems modeled by ODEs: – Motion under gravity – Simple harmonic motion

Coding Task: • Simulate motion over time using numerical ODE solvers

Outcome: Participants understood how time-evolving systems are simulated.

SESSION 8 – Astrophysical Simulations (Flagship Session)

- Two-body problem (planet–star system) • Orbit simulation and stability • Numerical errors and long-term behavior

Coding Task: • Simulate Earth's orbit (or simplified two-body system)

Outcome: Participants experienced the excitement of building real astrophysical simulations.

SESSION 9 – Data Visualization & Analysis in Astrophysics

- Handling datasets (CSV, arrays, time series) • Plotting trajectories, light curves, and spectra • Interpreting simulation results • Understanding noise, patterns, and physical meaning

Coding Task: • Analyze simulated or real astronomical data

Outcome: Participants learned to interpret computational results scientifically.

SESSION 10 – Mini Project + AI Connection

A computational problem was selected: – Orbit simulation – Light curve analysis – Numerical solution of a physics equation • Introduction to: – How numerical methods power AI/ML – Optimization and modeling in scientific computing

COURSE SNAPSHOT:

a. Expert-Led Computational Astronomy Sessions: The course featured insightful sessions delivered by experienced faculty and domain experts, providing participants with a strong conceptual foundation in numerical methods, scientific computing, and astrophysical problem-solving. Each session combined theory with practical demonstrations to enhance understanding.

b. From Numerical Concepts to Research Readiness, participants were introduced to the core computational tools used in modern astrophysics, including Python programming, numerical techniques, simulations, and data analysis workflows. These sessions helped learners understand how computation drives contemporary space science research and prepared them for research-oriented and industry-aligned scientific roles.

c. Access to Recorded Learning Resources to support continuous learning, recordings of all sessions were made available on the Graphy Dashboard. This enabled Participants to revisit the lectures, practice coding exercises, and strengthen their conceptual and computational understanding at their own pace.

d. Active Participation Through Feedback and Engagement Attendance for each session was documented through structured feedback forms, which also served as a platform for collecting participant reflections and ensuring active engagement throughout the course. This process helped maintain interaction and track learning progress.

e. Certification and Final Assessment. Participants who completed the course requirements were awarded a Course Completion Certificate. A Final Assessment Test was conducted to evaluate their understanding of numerical methods, Python applications, and computational astrophysics concepts covered during the program.

f. **Dr. Abha Khandelwal conducted an exclusive add-on Session 9 as a special surprise for the participants. The session, titled *"From Flowers to the Cosmos: How AI Learns to Classify Objects in Space,"* introduced participants to the fascinating application of Artificial Intelligence in astronomy.**

Through simple examples and engaging explanations, she demonstrated how AI, which is used to classify flowers in the Iris Dataset, can similarly be trained to identify stars, galaxies, exoplanets, and supernovae using astronomical data. The participants gained valuable insight into how AI recognizes patterns, learns from datasets, and assists scientists in analyzing massive amounts of space data efficiently.

The session generated great curiosity and enthusiasm among the participants, as they were able to understand how concepts of AI and Machine Learning can be connected with real-world scientific discoveries and modern space research. The surprise session added a unique interdisciplinary dimension to the bootcamp and was highly appreciated by all attendees

COURSE OUTCOMES:

Computational thinking for scientific problem-solving - Python for scientific computing - Core numerical methods (integration, root finding, differential equations) - Turning equations into simulations -Exploring the universe through computation - Data analysis and visualization - Foundation for AI and Machine Learning **Recorded Lectures:** Were made available on Graphy Dashboard for revision before final assessment.

CLOSING REMARKS:

The program concluded with an engaging interactive session led by Dr. Ojas, during which participants shared reflections and expressed great satisfaction with the enriching and informative session. They appreciated the depth of knowledge, clarity of presentation, and practical insights provided throughout the program.

Dr. Ojas conveyed his heartfelt gratitude to the **esteemed Resource Person, Dr. Sathyanarayan**, **for delivering an enlightening and thought-provoking session**. He appreciated his valuable guidance, scholarly contributions, and inspiring interaction with participants, which greatly enhanced the learning experience.

On behalf of himself and the entire organizing team, Dr. Ojas Garg also expressed **heartfelt**

gratitude to Dr. Abha Khandelwal, Patron and Mentor of AACST, for her invaluable guidance, constant encouragement, and unwavering support throughout the planning and execution of the course. He acknowledged that her mentorship and readiness to provide support at every stage provided strong direction and inspiration to the organizing team.

He further thanked all participants for their enthusiastic involvement, active participation, and thoughtful discussions that contributed significantly to the success of the program. The session concluded on a positive and motivating note with a vote of thanks and best wishes for future academic endeavors.Top of Form

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SUMMARY:

The mentor Dr Abha Khandelwal, expressed deep appreciation for the dedicated efforts and effective coordination of the Convener, Dr. Ojas Garg, whose meticulous planning and enthusiastic leadership contributed immensely to the grand success of the course. His commitment to ensuring meaningful learning experiences and smooth execution of every session was highly commendable.

The AstroCompute National-Level Online Course in Computational Astrophysics From Fundamentals to Advanced Exploration was designed to bridge the gap between the academic study of astrophysics and the practical use of computational methods in modern scientific research. The program received an enthusiastic response, with joining from diverse regions across India. This wide geographical representation reflected the growing interest among students, educators, and early-career researchers in computational astrophysics and its expanding relevance in both academic and industry-aligned scientific domains.

The course served as a structured pathway that guided learners from foundational numerical thinking to hands-on computational exploration of the universe. Through modules on Python fundamentals, numerical methods, simulations, and astrophysical data analysis, participants experienced how computation drives modern astrophysics. The program thus became a valuable platform for **knowledge exchange, skill development, and fostering awareness** about the evolving role of computation in astronomy, space science, and research-oriented STEM education.

REPORT PREPARED BY

AACST Editorial Team