SPECTRUM

VOLUME–3
(2024–25)

DEPARTMENT OF PHYSICS

J S S ACADEMY OF TECHNICAL EDUCATION, BENGALURU

JSSATE
BENGALURU

DEPARTMENT OF PHYSICS

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DEPARTMENT OF ISE
1JS24IS056

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DEPARTMENT OF ISE
1JS24IS057

Vision and Mission of the Institute

Vision:

To be among the finest Institutions providing Engineering and Management Education empowered with research, innovation and entrepreneurship.

Mission:

- Strive towards Excellence in teaching–learning process and nurture personality development.
- Encourage Research, Innovation & Entrepreneurship.
- Train to uphold highest ethical standards in all activities.

Vision and Mission of the Department

Vision:

Creating a thrust for research with societal concern by way of clear understanding the fundamentals of science and applying it to the real-time situation.

Mission:

- To mould a budding engineer with the finer aspects of the basics of Physics.
- To explore the opportunities to innovate in contributing to the advancement of Science and Technology.

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Editor

Dear Reader,

It is with great pleasure and a sense of continued accomplishment that we present the third volume of Spectrum, the official newsletter of the Department of Physics, JSSATE Bengaluru. With each edition, Spectrum has grown as a vibrant platform that captures the curiosity, creativity, and collaboration that define our department.

This volume brings you an even richer tapestry of content—ranging from cutting-edge research highlights and innovative projects to inspiring stories of student and faculty achievements. We have also introduced new sections that reflect the evolving landscape of physics and its intersections with technology, sustainability, and interdisciplinary innovation.

On behalf of the editorial team, I extend heartfelt thanks to our Principal, the Management, and all faculty members for their steadfast encouragement and support. My sincere gratitude also goes to the contributors, editorial members, and everyone who has been part of this journey. Your commitment continues to shape Spectrum into a valuable resource for knowledge sharing and inspiration.

We hope this edition not only informs but also ignites your curiosity and enthusiasm to explore the endless frontiers of Physics.

Happy reading!

Dr. Abhilasha Singh
M.Sc., Ph.D (BHU)
Assistant Professor
Department of Physics
e- mail: abhilashasingh@jssateb.ac.in

Physics Department Insights

As we proudly present the third volume of Spectrum, we continue to celebrate the dynamic evolution of the Department of Physics at JSSATE Bengaluru. The past year has been marked by meaningful progress, innovative teaching practices, and the strengthening of our role as a foundational pillar in engineering education.

Building on our legacy of excellence, the department has further deepened its engagement in cutting-edge research, industry-aligned projects, and student-centric learning. Our faculty members have expanded their academic contributions through impactful publications, funded proposals, and active participation in interdisciplinary forums, while our students have excelled in both academic and project-based arenas.

The Skill Laboratory initiative for first-year students has matured into a thriving platform that nurtures creativity and collaboration through hands-on exploration. The department's consistent efforts to bridge theoretical understanding with practical implementation continue to empower students to think critically and solve real-world problems.

This year, we have also enriched our academic environment through expert talks, technical events, and faculty development programs. These platforms have strengthened our collaborative spirit and opened new avenues for innovation and lifelong learning.

Physics Lab at a glance

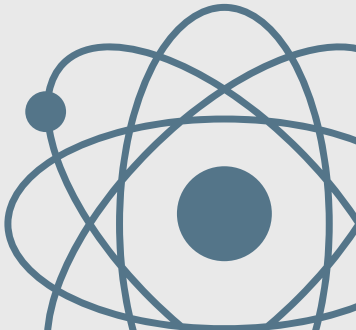
SKILL LAB PROJECTS

SKILL LAB PROJECTS

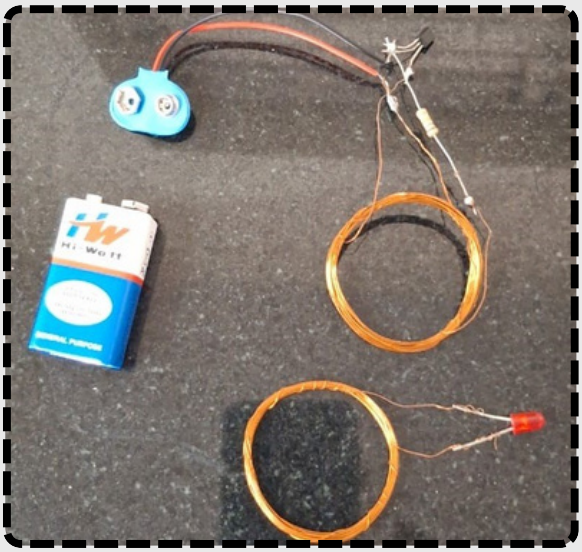
The Department of Physics at JSSATE, Bengaluru, is proactively committed to enhancing students' technical and practical capabilities through structured guidance and hands-on learning. As part of this initiative, the department has established a dedicated Skill Laboratory exclusively for first-year students. This lab is equipped with essential training kits and modules in electronics, mechanical systems, and information technology, among other domains.

Following the training session, fifteen students were organized into groups through a random selection process. During the Academic Year 2024–25, a total of twenty-two groups were formed in the first semester and thirty-two groups in the second semester, with each group assigned a specific problem statement. Every group was guided by a faculty supervisor who monitored progress and provided academic support. Students actively collaborated within their groups, engaged in regular discussions with their supervisors, and carried out literature reviews. Periodic visits to the Department of Physics skill laboratory were made to review progress. Weekly updates were submitted and presented to the faculty. Upon completion, each group presented their working project and submitted a detailed project report, with final demonstrations conducted in the presence of the supervisor and invited faculty members.

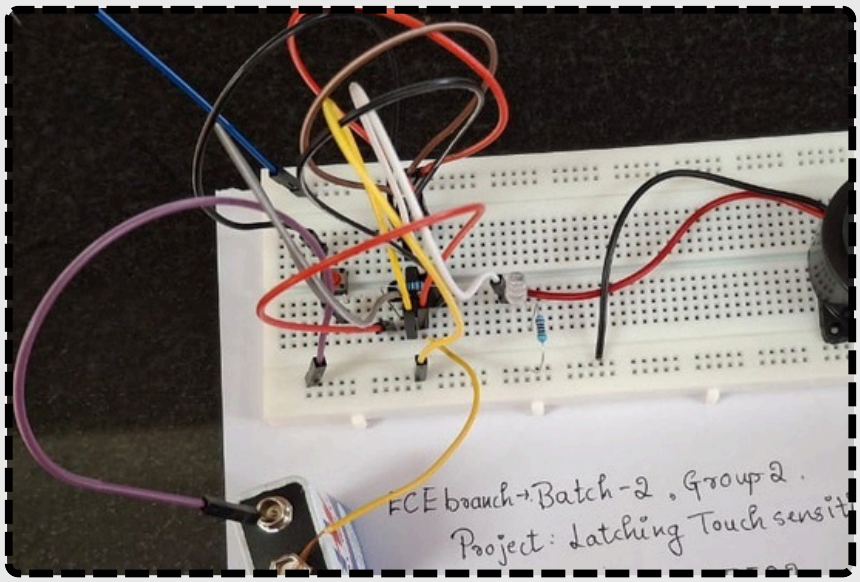
During the current Academic Year projects in various areas, including IoT, communication, smart technology, optics, energy storage, and Astrophysics were allocated.



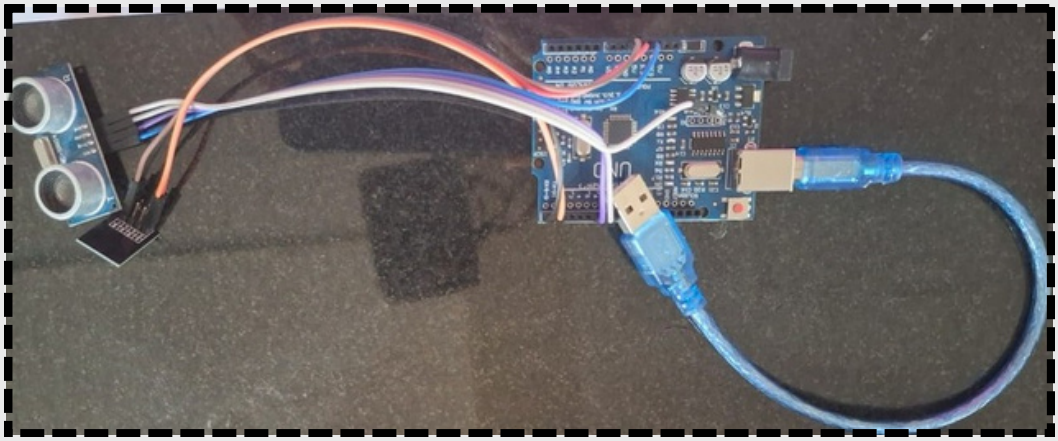
Skill Lab Projects



LED Bulb using Inductive Transfer method

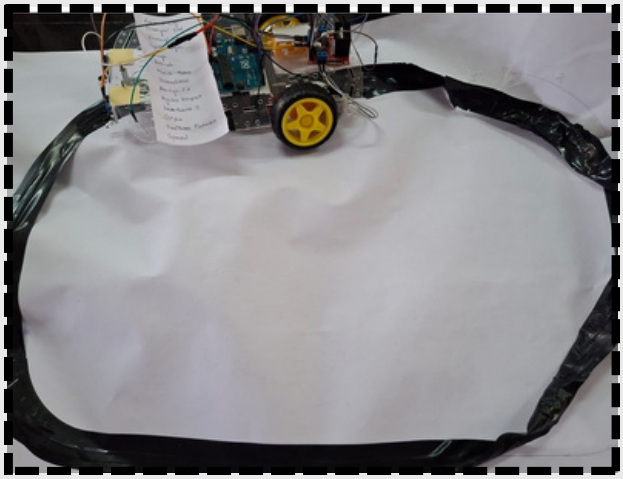


Latching Touch Sensitive Alarm

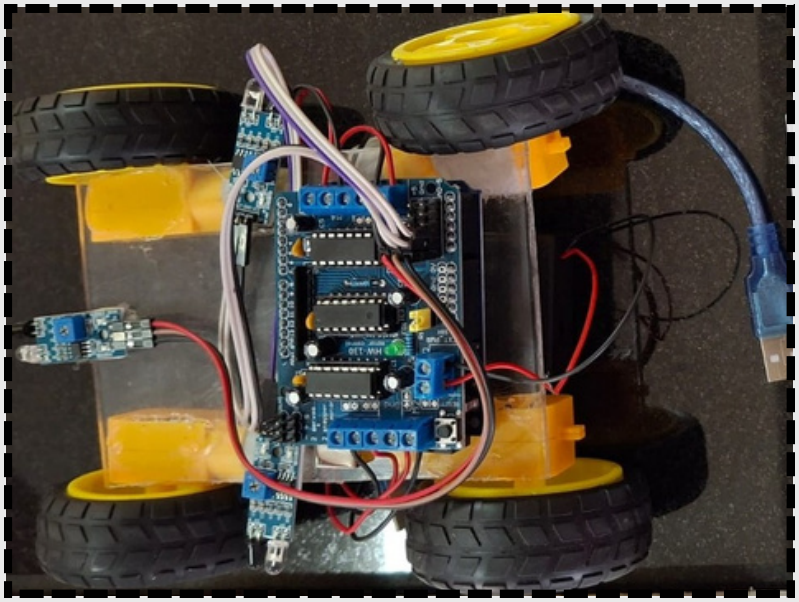


IOT Based Monitoring Garbage System

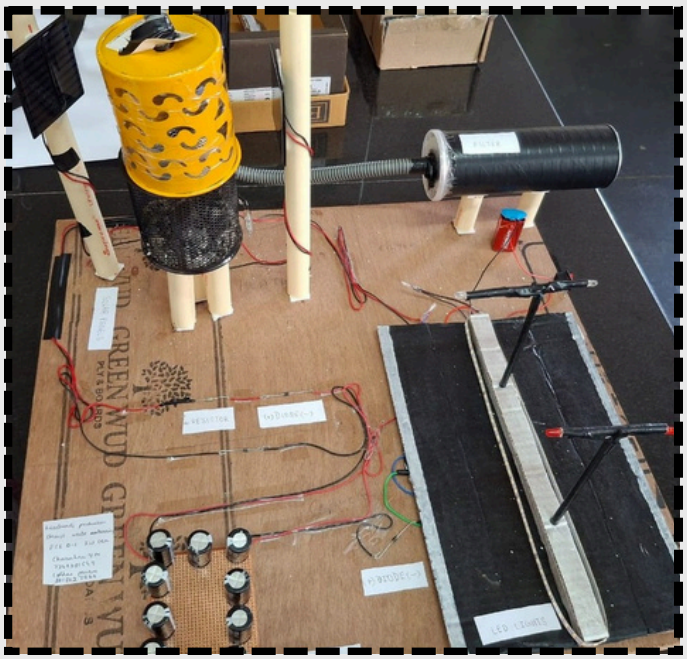
Skill Lab Projects



Line Follower Robot

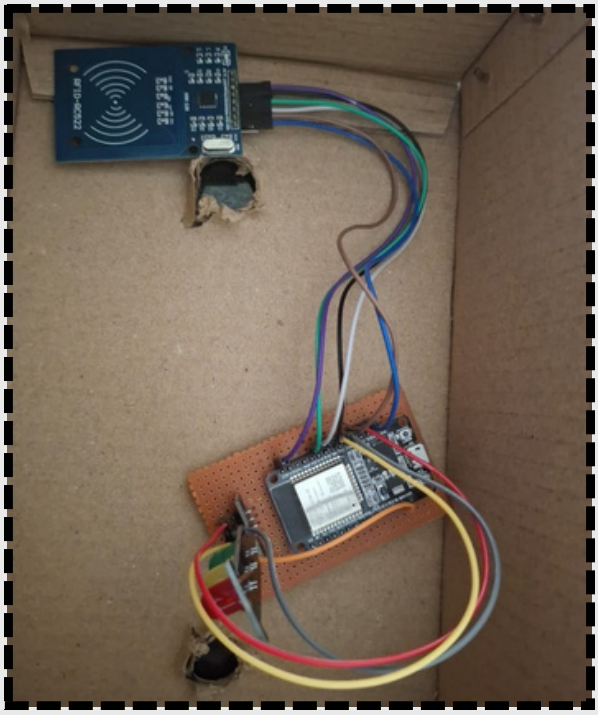


Maze Solving Car Using Arduino

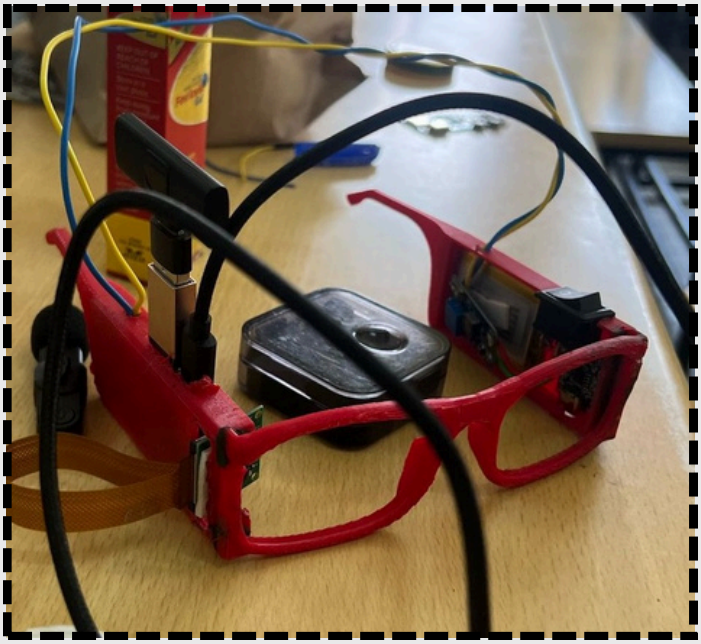


Production of Electricity Using Waste

Skill Lab Projects



RIF Based Smart Traffic Light Control System

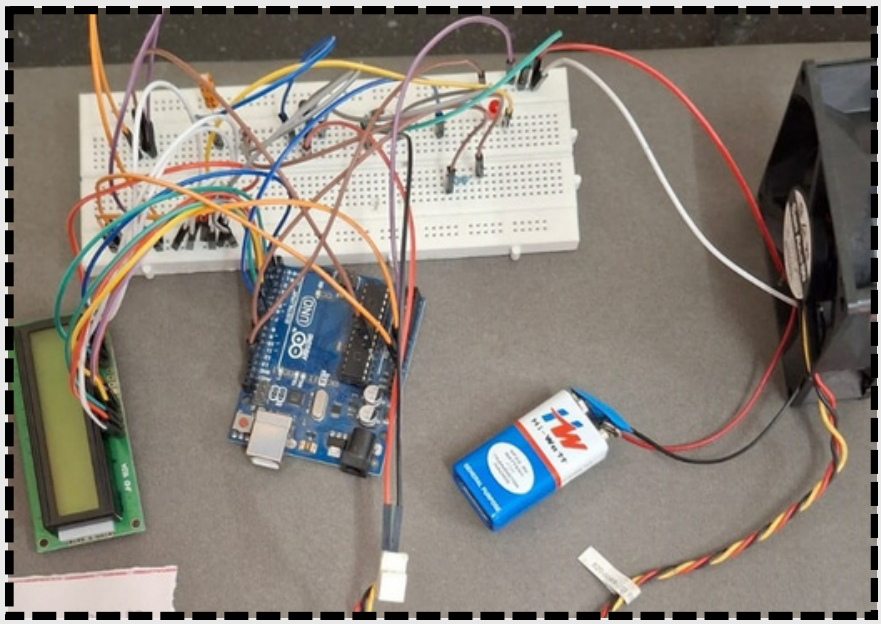


Smart glasses for enhanced mobility of the visually impaired

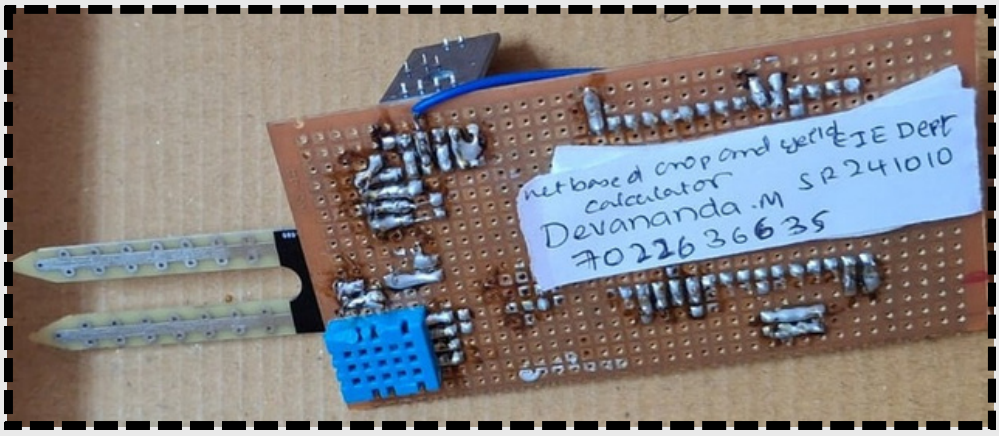
Solar powered charger

Skill Lab Projects

Sustainable floating house



Temperature based fan speed control and monitoring with arduino



The Smart Agricultural Monitoring System

Camera Integrated PPV Drone System:

Planned and executed by: B C Uttam and team (AIML Section)
Supervised by: Dr. Shashidhar R

The students of the AIML section have successfully developed a Camera Integrated PPV (Personal Point of View) Drone System as part of the Skill Lab initiative. This drone system is equipped with a high-resolution camera that provides a real-time aerial view, enabling live monitoring and data capture from various elevations and angles.

The Camera Integrated Miniature Drone System project showcases the seamless integration of electronics, mechanics, and communication technologies into a compact and functional aerial platform. The system incorporates a flight controller, FPV (First-Person View) camera, brushless motors, and wireless control mechanisms, enabling the drone to achieve stable flight and real-time video transmission. This innovative project is designed for diverse applications such as surveillance, remote inspections, disaster monitoring, and precision agriculture.

Eddy Current Jumping Desk Model:

Planned and executed by: Abhilash SN and team (ME Section)
Supervised by: Dr. Sushma KC

This project was undertaken by first-semester students from department of Mechanical Engineering (ME). The students successfully fabricated a jumping desk model, effectively bridges theoretical physics with practical engineering, showcasing the innovative potential of electromagnetism.

The Eddy Current Jumping Model explores the fascinating interaction between conductive materials and magnetic fields to generate non-contact forces like levitation or jumping. When a conductor moves within a magnetic field, it induces eddy currents within the material.

These currents create opposing magnetic forces in accordance with Lenz's Law, resulting in a repulsive effect that can cause the object to jump or levitate. This model provides a hands-on demonstration of electromagnetic principles and is particularly significant in understanding applications such as magnetic braking, induction heating, and maglev transportation systems.

Air mouse :

Planned and executed by: Atharva Joshi and team (CSE B Section)
Supervised by: Mr. Mohanakumara LB

The students of CSE-B section have designed an innovative Wireless Air Mouse, a device that allows users to control a computer cursor through hand gestures and motion, without the need for a traditional surface. This device uses motion sensors and wireless communication to translate physical movements into cursor navigation, enhancing the ease of interaction with digital systems.

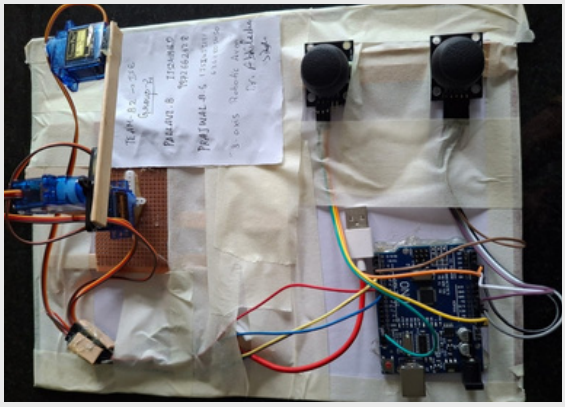
The Wireless Air Mouse is particularly useful for presentations, smart TVs, and interactive applications, offering a more intuitive and flexible user experience. This project reflects the students' creativity in merging hardware interfacing with wireless technologies, showcasing practical applications of computer science and electronics.

Robotic Arm:

Planned and executed by: P Meghala and team (ISE B Section)
Supervised by: Dr. Abhilasha Singh

The students of ISE-B section have successfully constructed a Robotic Arm capable of performing precise and controlled movements. Designed with servo motors, sensors, and a microcontroller, the robotic arm mimics human arm motions to execute tasks such as picking, placing, and rotating objects.

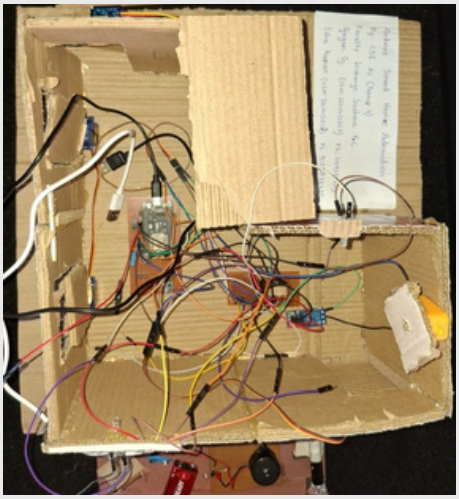
This project demonstrates core concepts of robotics, automation, and control systems, making it applicable in areas like manufacturing, medical assistance, and laboratory automation. The initiative reflects the students' ability to combine mechanical design with programming skills, providing a foundation for future innovations in the field of robotics.



Smart Home Technology:

Planned and executed by: Gagan G and team (CSE A Section)
Supervised by: Dr. Sushma KC

The CSE-A section students have developed an innovative Smart Home Technology system designed to automate and simplify household operations. This project utilizes IoT-based devices, sensors, and wireless connectivity to remotely control and monitor home appliances such as lights, fans, and security systems through smartphones or voice commands.

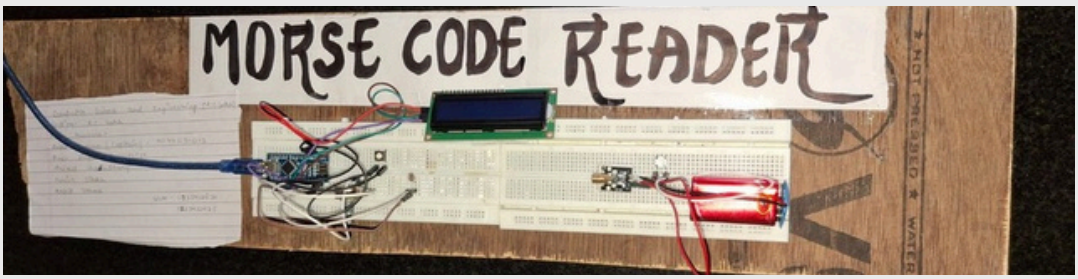


The system enhances convenience, security, and energy efficiency, making modern homes smarter and more sustainable. This project reflects the students' ability to apply computer science principles in real-world solutions, showcasing advancements in automation and smart living.

Morse Code Reader:

Planned and executed by: Ansh Singh and team (CSE A Section)
Supervised by: Dr. Sushma KC

The students from the CSE group have successfully designed a Morse Code Reader that deciphers Morse code signals using an Arduino, I2C LCD display, laser transmitter, and LDR (Light Dependent Resistor) receiver.which controls the robot's movement. The laser transmitter sends coded light pulses, which are detected by the LDR sensor. The Arduino processes these pulses, decodes the Morse code, and displays the corresponding characters on the LCD screen.



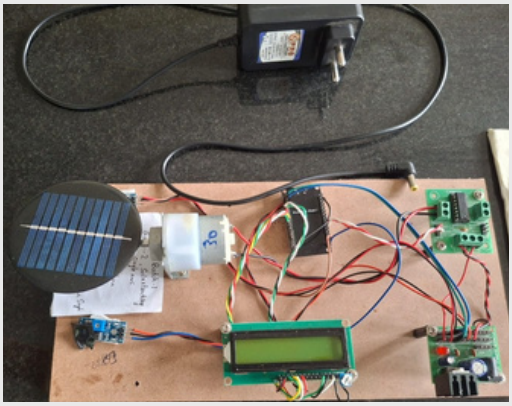
This project effectively demonstrates the practical application of embedded systems, optics, and communication protocols, offering insights into wireless optical communication and signal decoding. It also serves as a creative educational tool for understanding the fundamentals of digital communication.

Solar Tracking System - Single axis:

Planned and executed by: Abhinav Chandra HS and team (AIML Section)
Supervised by: Dr. Prasanna Kumara S

The students from the ISE branch have designed a Single Axis Solar Tracking System to improve the efficiency of solar energy collection. The system employs a microcontroller (ESP32), a motor driver, and a DC motor to dynamically adjust the position of a solar panel in alignment with the sun's movement throughout the day.

By continuously orienting the panel towards the sun, the system maximizes solar energy absorption compared to fixed panels. This project highlights the students' understanding of renewable energy solutions, embedded systems, and automation, contributing to sustainable energy technologies.

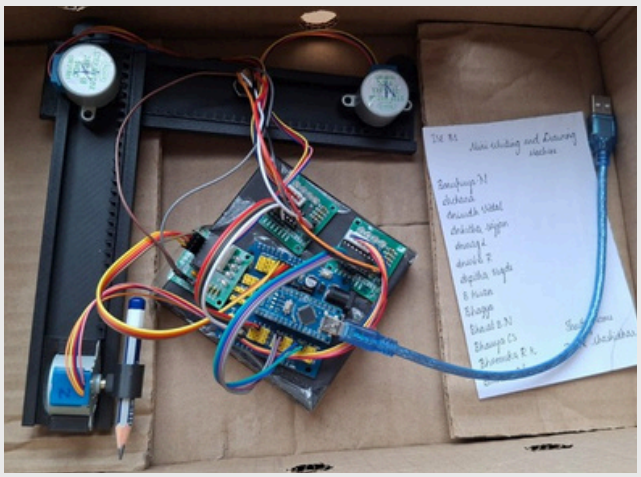


Mini Writing and Drawing Machine:

Planned and executed by: Banupriya N and team (CSE C Section)
Supervised by: Dr. Shashidhar R

The students from ISE A of the second semester have designed a mini writing and drawing machine to automate simple writing and drawing tasks using programmed instructions. The machine successfully demonstrates how automation and mechanical design can be integrated to perform precise, programmable tasks.

It utilizes Computer Numerical Control technology where predefined codes (G-code) guide the machine's movement. This mini project showcases the integration of automation, electronics, and mechanical systems on a small scale, using basic components such as stepper motors, Arduino, servo motors, and 3D-printed or laser-cut frames.

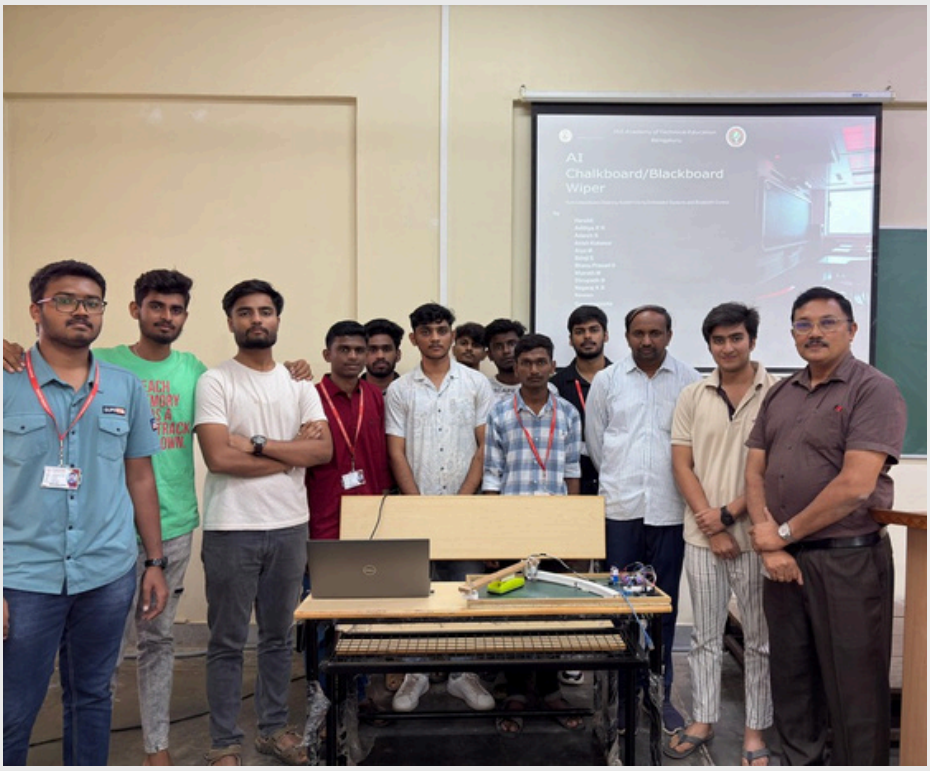


AI Chalkboard/Blackboard Wiper:

Planned and executed by: Harshit and team (AIML A Section)
Supervised by: Dr. Shashidhar R

The students from CSE A have undertaken an innovative project on an AI Chalkboard/Blackboard. This system is designed to automate writing on a blackboard using a wireless control mechanism. The project employs key components such as Arduino Uno, L298 motor driver, and an HC-05 Bluetooth module to enable remote operation. Through this project, the students demonstrated the practical application of automation, control systems, and wireless communication in enhancing traditional teaching tools.

The project offers a practical, cost-effective, and scalable solution that addresses real-world needs in educational institutions.




DEPARTMENT
ACTIVITIES

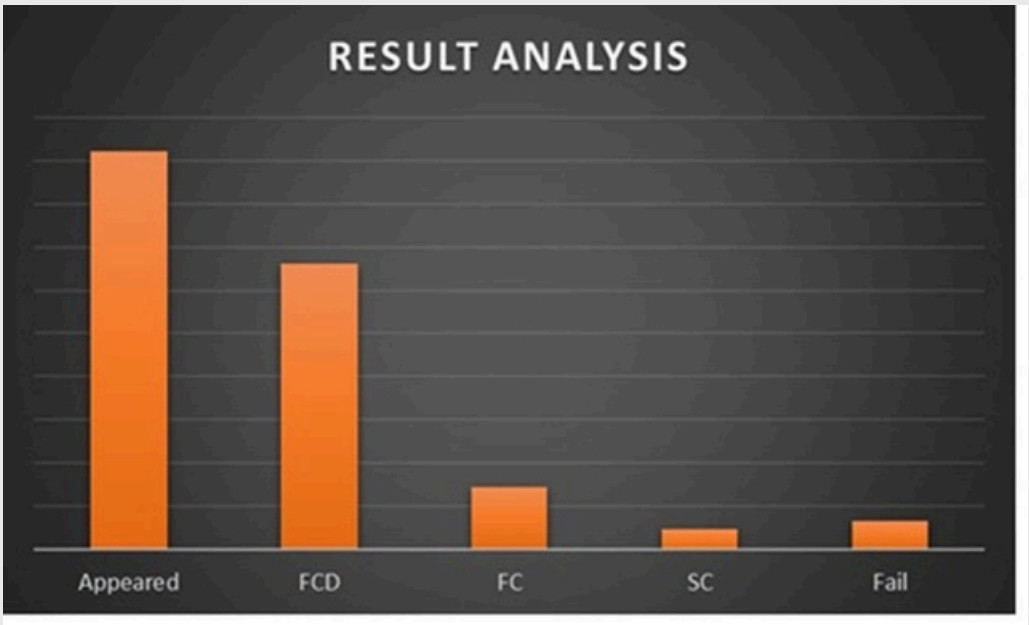
RESEARCH EXCELLENCE

MR. PRAKASHA GS

Heartiest congratulations to Mr. Prakasha GS on successfully completing Ph.D. from the Department of Physics, under the supervision of Dr. Shashidhar R(Guide) in the academic year 2024-25

Academic Excellence

Analysis of Physics Results for the Academic Year 2024-25



Even Semester

Odd Semester

JSSATE BENGALURU

Department of Physics

VTU SEE RESULT (I SEMESTER, FEBRUARY 2025)

OUR TOPPERS

FCD: 48.29%
FC: 23.83%
Pass: 86.08%

Applied Physics for EEE Stream

Lakshmi SN
1JS24EC066
93 Marks

Shripurna J Patil
1JS24EC150
91 Marks

Dawan B
1JS24EC036
90 Marks

Pruthvi P Hegde
1JS24EC107
90 Marks

Harshitha JN
1JS24EI019
89 Marks

Applied Physics for ME Stream

CM Lohith
1JS24ME012
90 Marks

Applied Physics for Civil Stream

Stuthi Maiya
1JS24RA024
92 Marks

Niveditha MP
1JS24CV017
89 Marks

Best Wishes from

Management, Principal, HODs, Faculty and Staff

JSSATE BENGALURU

Department of Physics

VTU SEE RESULT (II SEMESTER, JULY 2025)

OUR TOPPERS

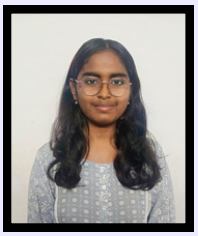
Our 90's Club: 76 students

FCD %: 72
FC % :16

Pass %: 93

Chidananda KP
1JS24CS048
98

Chinmayi Rao
1JS24CI022
98



Nayana DK
1JS24CS116
98

Ashika
1JS24CS029
97

Deepika B N
1JS24CS048
99

Meera
1JS24IS093
100

Nishitha PR
1JS24CI047
100

Sughosh JS
1JS24CS168
99

Lakshitha R
1JS24CS092
97

Pragna
1JS24CS128
97

Bhargavi S
1JS24CI016
97

Paavani Gowda M
1JS24CI048
97

Best Wishes from

Management, Principal, HODs, Faculty and Staff

FACULTY PUBLICATIONS (2024-2025)

Indian Journal of Science and Technology
DOI: 10.17485/IJST/v18i24.758
Year: 2025, Volume: 18, Issue: 24, Pages: 1896-1907
Original Article

Influence of Thickness on Structural, Morphological, Compositional and Optical Properties of RF-Sputtered Al:ZnO Thin Films

S Uday Balegar[1], R Shashidhar[2], A Raghu[1,3*]

[1]Department of Physics, Government First Grade College (Autonomous), Mandya, 571401, Karnataka, India
[2]Department of Physics, J S S Academy of Technical Education, Bengaluru, 560060, Karnataka, India
[3]Government Science College (Autonomous), Hassan

*Corresponding Author
Email: raghua4@gmail.com

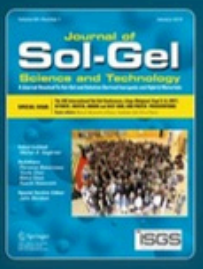
Received Date:27 April 2025, Accepted Date:04 May 2025, Published Date:18 June 2025

Year: 2025, Volume: 18, Issue: 24

Home > Journal of Sol-Gel Science and Technology > Article

Influence of air annealing on the characteristics of spray-deposited TiO_2 thin films and their use as NO_2 gas sensors

Original Paper | Published: 02 September 2025
Volume 116, pages 1114–1131, (2025) Cite this article



Physica Scripta

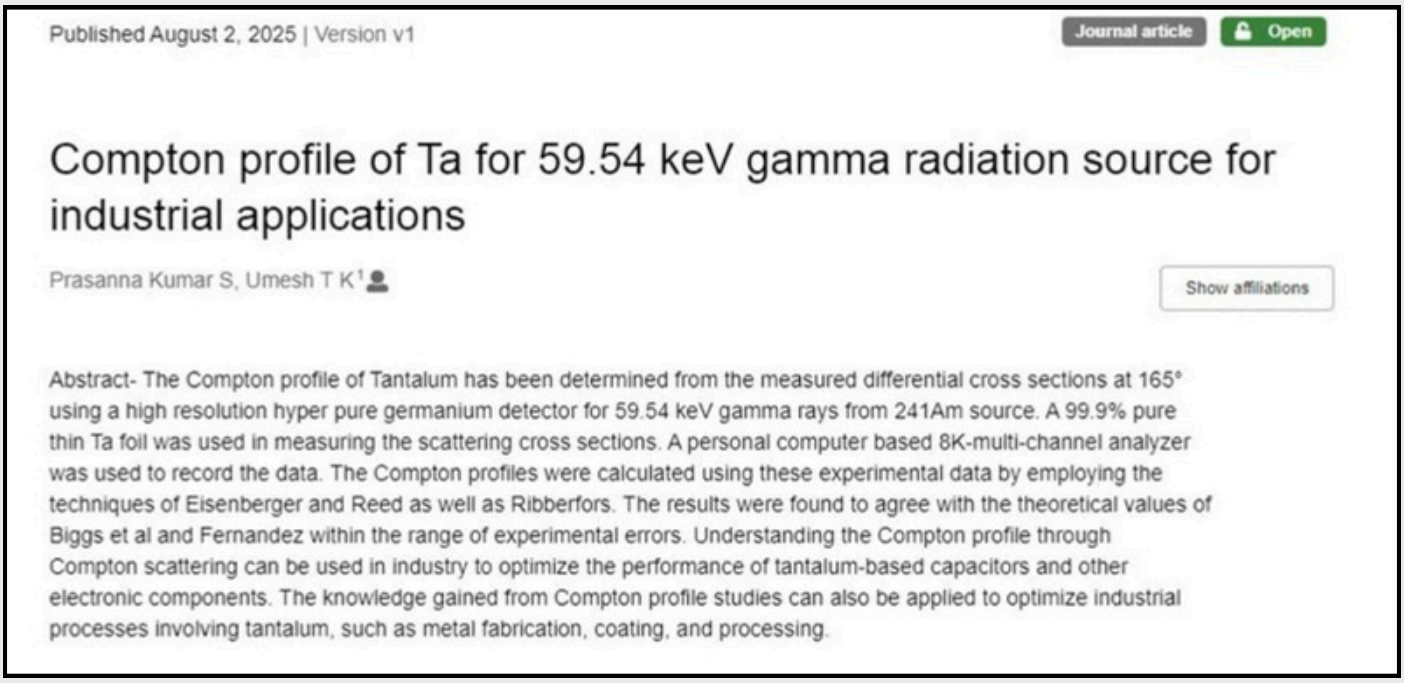
PAPER

Growth and characterization of oxygen-annealed ZnO and Al:ZnO thin films for enhanced nitrogen dioxide gas sensing prepared by RF sputtering

Uday Balegar S, R Shashidhar, R S Madhukeswara and Raghu A*

Physica Scripta, Volume 100, Number 11

FACULTY PUBLICATIONS (2024-2025)



Published August 2, 2025 | Version v1

Journal article Open

Compton profile of Ta for 59.54 keV gamma radiation source for industrial applications

Prasanna Kumar S, Umesh T K[1]

Show affiliations

Abstract- The Compton profile of Tantalum has been determined from the measured differential cross sections at 165° using a high resolution hyper pure germanium detector for 59.54 keV gamma rays from 241Am source. A 99.9% pure thin Ta foil was used in measuring the scattering cross sections. A personal computer based 8K-multi-channel analyzer was used to record the data. The Compton profiles were calculated using these experimental data by employing the techniques of Eisenberger and Reed as well as Ribberfors. The results were found to agree with the theoretical values of Biggs et al and Fernandez within the range of experimental errors. Understanding the Compton profile through Compton scattering can be used in industry to optimize the performance of tantalum-based capacitors and other electronic components. The knowledge gained from Compton profile studies can also be applied to optimize industrial processes involving tantalum, such as metal fabrication, coating, and processing.

Phase Transitions ›

A Multinational Journal

Volume 98, 2025 - Issue 6-7

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60 Views

0 CrossRef citations to date

0 Altmetric

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Articles

Application of thermodynamic model to study the electro-optical and structural properties of ferroelectric liquid crystal W-212

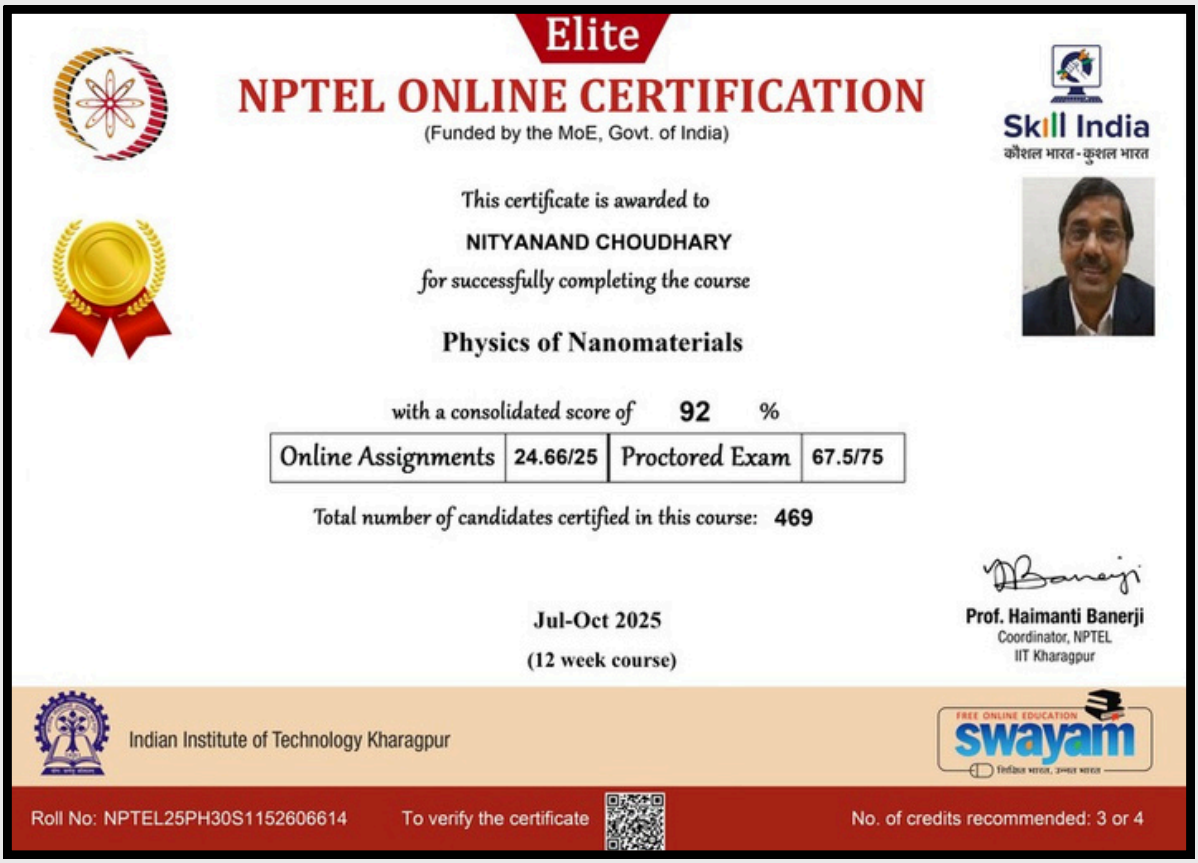
Abhilasha Singh & Shri Singh

Pages 432-440 | Received 15 Apr 2025, Accepted 27 Jun 2025, Published online: 07 Jul 2025

Cite this article https://doi.org/10.1080/01411594.2025.2528804

Activities

Dr. Nityanand Choudhary successfully completed the NPTEL online certification course Physics of Nanomaterials (Jul-Oct 2025), offered by IIT Kharagpur. He secured an Elite certificate with an impressive 92% consolidated score, demonstrating strong understanding of nanoscale physics and advanced material concepts.



Activities

Dr. Prasanna Kumar S, Professor, Department of Physics, JSSATE, Bengaluru-60 delivered an oral presentation titled “Compton Profile for Iron and Copper by Compton Scattering from a 241 Am Source” on 28.11.2025, in the International Conference on Applied Sciences and Advanced Materials ICASAM-2025 held at BNMIT, Bengaluru, highlighting experimental techniques and the importance of electronic structure studies of transition metals. The conference provided significant academic and professional benefits to both the engineering faculty and to the students. The expert talks, technical paper presentations, and interdisciplinary interactions significantly contributed to academic growth, research orientation, and awareness of sustainable engineering practices, thereby fulfilling the objectives of outcome-based engineering education.

B. N. M. Institute of Technology

An Autonomous Institution under VTU.

Certificate

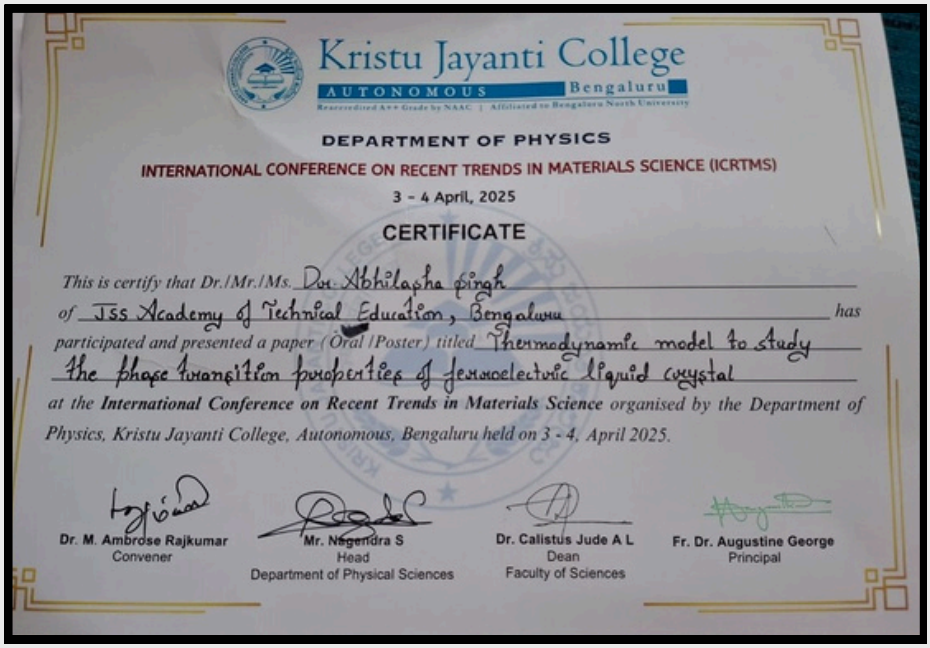
Dr./Prof./Mr./Mrs. Dr.Prasanna Kumar S of JSS Academy of Technical Education Participated/Presented a Paper titled Compton Profile for Iron and Copper by Compton Scattering From A 241AM Source in the International Conference on "Applied Sciences and Advanced Materials ICASAM-2025" Organized by Departments of Physics, Chemistry, Mathematics & Mechanical Engineering, BNMIT, Bengaluru held during November 28th & 29th, 2025.

Dr. Krishnamurthy G. N. — Deputy Director
Prof. Eishwar N. Maanay — Dean
Dr. S. Y. Kulkarni — Additional Director & Principal
Prof. T. J. Rama Murthy — Director

Activities

Dr. Abhilasha Singh attended and presented a research paper titled "Thermodynamic Model to Study the Phase Transition Properties of Ferroelectric Liquid Crystal" at the International Conference on Recent Trends in Material Science, organized by the Department of Physics, Kristu Jayanti College, Bengaluru, held on 3–4 April 2025.

Her contribution highlighted significant insights into the thermodynamic modelling of phase transitions in ferroelectric liquid crystals, adding value to the ongoing research in advanced material science.



Kristu Jayanti College
AUTONOMOUS Bengaluru

DEPARTMENT OF PHYSICS

INTERNATIONAL CONFERENCE ON RECENT TRENDS IN MATERIALS SCIENCE (ICRTMS)

3 - 4 April, 2025

CERTIFICATE

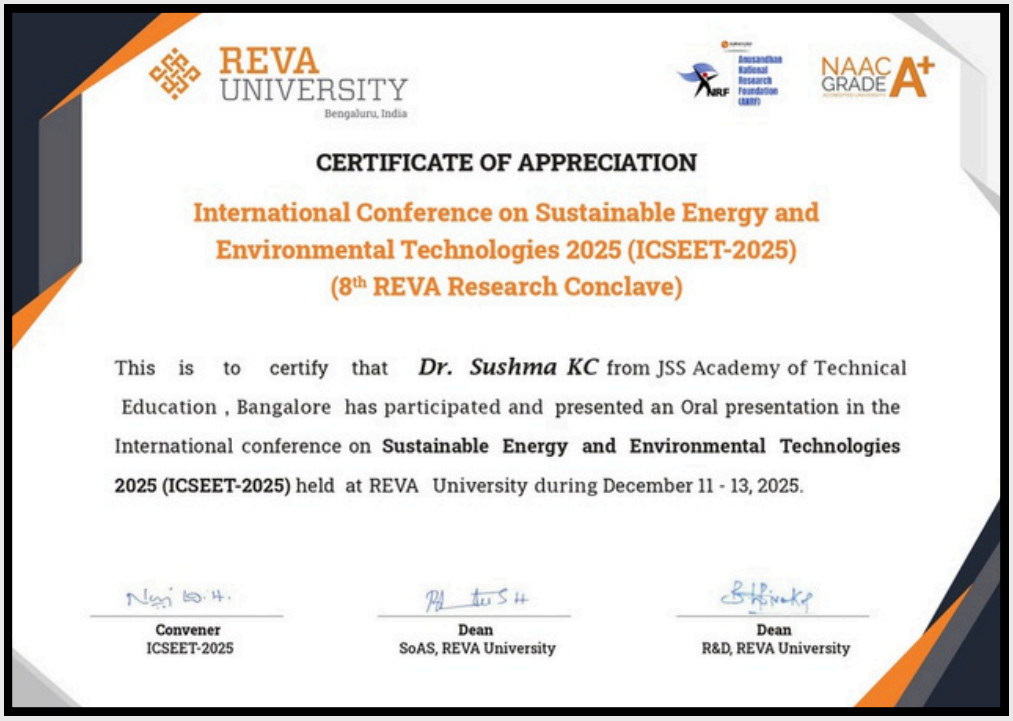
This is certify that Dr./Mr./Ms. Dr. Abhilasha singh
of JSS Academy of Technical Education, Bengaluru has
participated and presented a paper (Oral/Poster) titled Thermodynamic model to study
the phase transition properties of ferroelectric liquid crystal
at the International Conference on Recent Trends in Materials Science organised by the Department of Physics, Kristu Jayanti College, Autonomous, Bengaluru held on 3 - 4, April 2025.

Dr. M. Ambrose Rajkumar, Convener
Mr. Nagendra S, Head, Department of Physical Sciences
Dr. Calistus Jude A L, Dean, Faculty of Sciences
Fr. Dr. Augustine George, Principal

Activities

Dr. Sushma KC attended and presented a research paper at the International Conference on Sustainable Energy and Environmental Technologies 2025 (ICSEET-2025) held at Reva University, Bangalore on 11–13 Dec 2025.

This work reports the green synthesis of near UV excited SrZrO3:Eu3+ red-emitting phosphors using Aloe vera gel as fuel. The structural and luminescent properties were systemically investigated, revealing high-colour purity, good quantum efficiency and suitability as a red component for wLED applications.



REVA UNIVERSITY
Bengaluru, India

NAAC GRADE A+

CERTIFICATE OF APPRECIATION

International Conference on Sustainable Energy and Environmental Technologies 2025 (ICSEET-2025)
(8th REVA Research Conclave)

This is to certify that ***Dr. Sushma KC*** from JSS Academy of Technical Education , Bangalore has participated and presented an Oral presentation in the International conference on **Sustainable Energy and Environmental Technologies 2025 (ICSEET-2025)** held at REVA University during December 11 - 13, 2025.

Convener
ICSEET-2025

Dean
SoAS, REVA University

Dean
R&D, REVA University

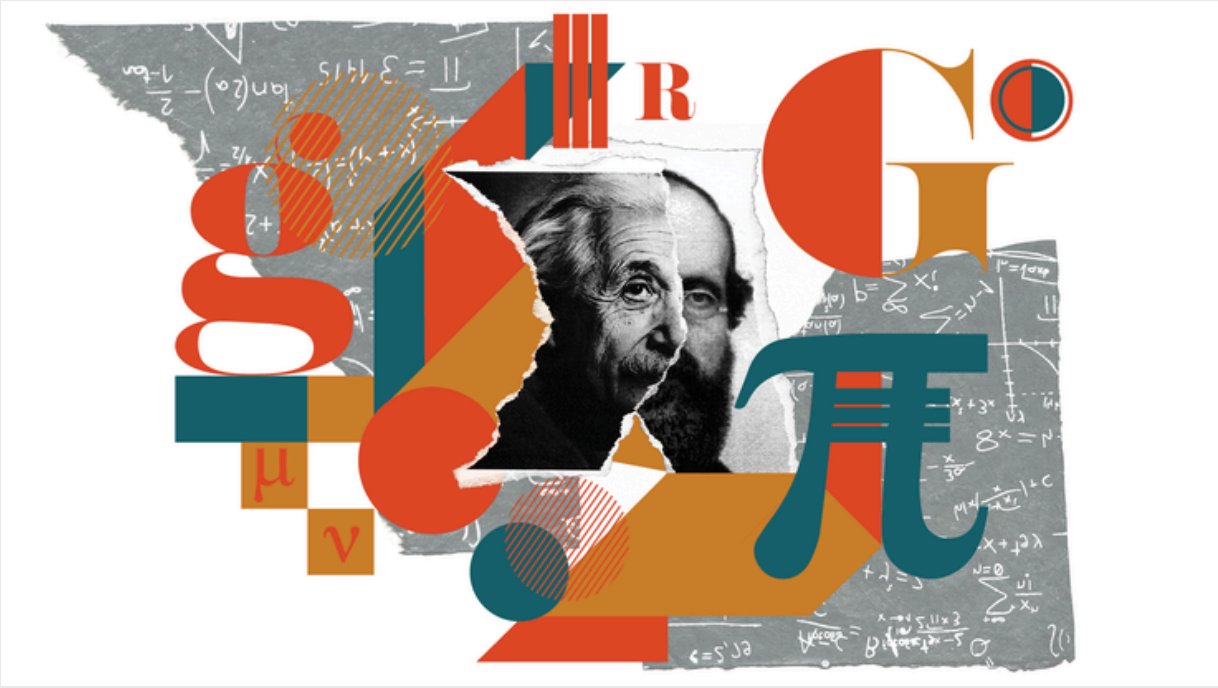
Activities

Dr. Prasanna Kumar S, Dr. Abhilasha Singh, Dr. Sushma K. C., and Mr. Mohanakumara L. B. attended a Five-Day Faculty Development Programme (FDP) on “Quantum Frontiers: Materials, Modelling & Computing” held from 8th to 12th September 2025 at Ramaiah Institute of Technology, Bengaluru. The programme introduced participants to emerging trends and applications in quantum science and technology, with a focus on quantum materials, computational modelling, and quantum computing. It featured expert lectures and hands-on sessions delivered by distinguished scientists and academicians from renowned institutions including the Raman Research Institute (RRI), IISc Bengaluru, RUAS, MSRIT, and AWS, providing valuable insights and exposure to cutting-edge research and tools in the field.

Activities

Dr. Shashidhar R, HOD Physics, successfully coordinated the "First International Conference on Intelligent Computing and Communication Systems (CICCS-25)", organized in association with IEEE Bengaluru and held from 18th to 20th September 2025 at JSSATE, Bengaluru. As part of the conference activities, first-year students from the Physics Skill Lab showcased their innovative projects at the Physics Department Skill Lab. The event also attracted enthusiastic participation from school students of Classes 10 and 12 across Bengaluru, who visited the exhibition to explore and appreciate the projects developed by JSSATE students.

ARTICLES



Discipline Is the Key to Success in Student Life

Dr. Prasanna Kumara S
Professor, Physics

Discipline plays a vital role in shaping a student's life and determining future success. Student life is the foundation period during which habits, attitudes, and values are formed. Among all the qualities required to achieve academic excellence and personal growth, discipline stands out as the most important.

It acts as a guiding force that helps students remain focused, responsible, and committed to their goals. Discipline begins with self-control and the ability to follow rules and routines.

A disciplined student manages time effectively, balances studies with extracurricular activities, and avoids unnecessary distractions. Regular study habits, punctuality, and consistency in effort enable students to understand concepts deeply rather than relying on last-minute preparation. Such practices reduce stress and build confidence, leading to better academic performance. In addition to academics, discipline shapes character. It teaches students respect for teachers, parents, and peers, and instills values such as honesty, patience, and perseverance. Through discipline, students learn to accept responsibilities and face challenges with determination. Even failures become learning opportunities when approached with a disciplined mindset. Discipline also plays a crucial role in developing long-term success skills. Students who are disciplined during their formative years are more likely to become organized professionals and responsible citizens. They learn to set realistic goals, plan their actions, and work steadily towards achievement. This habit of consistent effort is often more important than talent alone. Moreover, discipline helps students make wise choices. In an age filled with distractions such as social media and digital entertainment, disciplined students are better equipped to prioritize their studies and personal development. They understand the importance of delayed gratification and focus on long-term benefits rather than short-term pleasures.

Discipline Is the Key to Success in Student Life

A powerful mythological example of discipline in student life can be seen in Arjuna from the Mahabharata. Arjuna is remembered not only for his skill in archery but also for his extraordinary discipline and unwavering focus. As a student of Guru Dronacharya, Arjuna followed a strict routine of practice, obedience, and self-control. He respected his teacher, followed every instruction sincerely, and practiced tirelessly day and night.

When Guru Dronacharya tested his students by asking them to aim at the eye of a bird, Arjuna alone could focus solely on the target, ignoring all distractions. This intense concentration was the result of years of disciplined training. Arjuna's discipline helped him master archery and earn the title of the greatest archer of his time. Even during challenging situations, he remained committed to learning and self-improvement. His success was not due to talent alone but to consistent effort, obedience, and mental discipline. This mythological example clearly shows that discipline, focus, and dedication during the learning phase lead to excellence and success, making Arjuna an ideal role model for students even today.

In conclusion, discipline is the cornerstone of success in student life. It nurtures academic excellence, moral values, and personal growth. By cultivating discipline early, students lay a strong foundation for a successful and meaningful future. Truly, discipline is not a restriction but a path that leads students toward achievement, confidence, and lifelong success.

Black holes

Black holes are among the most fascinating and mysterious objects in the universe. They are regions in space where gravity is so strong that nothing—not even light—can escape from them. Although black holes cannot be seen directly, scientists have gathered compelling evidence of their existence through indirect observations and theoretical predictions.

Vaibhav Kulkarni
1JS24CS174
CSE-2nd Sem

What is a Black Hole?

A black hole forms when a massive star exhausts its nuclear fuel and collapses under its own gravity. This collapse compresses the star's core into an incredibly dense point called a singularity, surrounded by a boundary known as the event horizon. Once something crosses this boundary, it can never escape.

Black holes come in different sizes:

- Stellar Black Holes: Formed by the collapse of massive stars, these have a mass of about 5 to 20 times that of the Sun.
- Supermassive Black Holes: Found at the center of most galaxies, including our own Milky Way, these have masses ranging from millions to billions of times that of the Sun.
- Intermediate Black Holes: These are believed to be in between stellar and supermassive black holes but are harder to detect.
- Primordial Black Holes: Hypothetical black holes formed in the early universe, potentially smaller than other types.

Since black holes emit no light, astronomers detect them by observing their effects on nearby matter. Some common methods include:
X-ray Emissions
Gravitational Lensing
Orbital Movements
Gravitational Waves
Famous Black Holes

- Sagittarius A*: The supermassive black hole at the center of the Milky Way, with a mass of about 4 million Suns.
- M87 (Messier 87)**: The first black hole ever imaged, captured by the Event Horizon Telescope in 2019.
- Cygnus X-1: One of the first suspected black holes, located in the constellation Cygnus.

Why are black holes are important ?

Black plays a very crucial role in understanding gravity and time and structure of the universe they are laboraties for testing Einstein's theory of relativity and help to explain how galaxies evolve recent discoveries even suggest that black hole can merge, releasing gravitational waves -ripples in space time.

Conclusion:

Black whole are not just cosmic vacuum cleaners they are key to unlocking the many mysteries of the universe through visible and aften teared they are central to modern astrophysics and continue to intrigue scientists and the public alike