

*Tuesday*



*Talk*



**MAY 2025**

**HOSTED BY: RESEARCH DEVELOPMENT CELL AND FACULTY COUNCIL  
IN COLLABORATION WITH IQAC,  
PRASANTA CHANDRA MAHALANOBIS MAHAVIDYALAYA, KOLKATA**

**DATE: 06.05.2025**

**TIME: 1:30P.M.**

**VENUE: SEMINAR ROOM**

**MODERATOR: Dr. Puja Biswas**



**Understanding the Science and  
Innovations in the Dye Industry**

**Dr. Kamala Mitra**

**Asst. Professor & HOD**

**Department of Chemistry**

# TUESDAY TALK\_May, 2025

## **Understanding the Science and Innovation in the Dye Industry**

*Presented by **Dr. Kamala Mitra**, Assistant Professor of Chemistry,*

*Prasanta Chandra Mahalanobis Mahavidyalaya*

### **ABSTRACT**

The dye industry, deeply rooted in human civilization and continuously shaped by scientific advancement, represents a fascinating interplay between art, chemistry, and environmental responsibility. This paper examines the historical evolution of dyeing practices, beginning with ancient civilizations that relied on natural pigments and empirical processes derived from plants, insects, and minerals. Early dyeing methods were sustainable by necessity, though often limited in colorfastness and scalability. As chemistry matured during the Industrial Revolution, synthetic dyes emerged, enabling vivid and durable colors suitable for mass textile production. While this transformation greatly accelerated textile manufacturing, it also introduced significant environmental concerns, including toxic effluents, water pollution, and non-biodegradable waste. The paper explores contemporary innovations that seek to address these challenges through sustainable and technological solutions. Techniques such as digital textile printing, enzyme-assisted dyeing, and waterless dyeing with supercritical carbon dioxide have significantly improved efficiency and reduced ecological impact. In parallel, advances in biotechnology, particularly microbial dye synthesis and synthetic biology, are reviving natural dye use with industrial scalability. Furthermore, artificial intelligence and machine learning are being deployed to optimize dyeing parameters, reduce resource consumption, and automate quality control. The global demand for sustainable fashion and stricter environmental regulations have prompted a re-evaluation of dyeing practices. Industry leaders are increasingly incorporating closed-loop systems, bio-based dyes, and circular economy models to minimize waste and enhance resource recovery. This article argues that by combining ancient techniques with modern scientific innovation and digital intelligence, the dye industry can transition to a sustainable future. The fusion of tradition and technology not only ensures vibrant textiles but also fosters environmental responsibility, creating a more ethical and ecologically sound global textile economy.





Speaker