JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Comprehensive Examination - 2025

Ph.D (PMS)

COURSE CODE (CREDITS): 17P1WPH131 MAX. MARKS: 100

COURSE NAME: Comprehensive Test

COURSE INSTRUCTORS: Dr. Ragini Raj Singh MAX. TIME: 3 Hours

Note: *(a) All questions are compulsory.*
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Sec A (34 Marks)

Q.No	Question	Marks
Q1	Critically discuss the scientific basis, methodology, and applications of nanoconjugate formulations that combine conventional fungicides with engineered nanoparticles to achieve a synergistic antifungal effect. Your answer should include:	
	1. Scientific Rationale o Explain why conjugating existing fungicides with nanoparticles can enhance antifungal efficacy. o Include mechanisms of action such as improved bioavailability, controlled release, targeted delivery, and multi-modal toxicity.	*(8)*
	2. Types of Nanoparticles and Surface Functionalization o Describe suitable nanoparticles o Explain the role of surface chemistry, stabilizers, and functional groups in enabling conjugation with fungicides.	*(7)*
	3. Formulation Strategies and Characterization Techniques o Discuss chemical/physical methods used to conjugate fungicides with nanoparticles (e.g., ligand exchange, adsorption, covalent bonding, encapsulation). o Provide the characterization techniques required to confirm conjugation and evaluate physicochemical properties	*(7)*
	4. Assessment of Synergistic Effects o Explain how synergy is quantified using biological assays (e.g., MIC reduction, percent inhibition, toxicity indexes, FIC indices). o Discuss experimental design for in-vitro and in-vivo antifungal testing.	*(6)*
	5. Risks, Limitations, and Future Prospects o Evaluate potential environmental, toxicological, and regulatory challenges associated with nano-enabled fungicides. o Suggest future research directions for sustainable nanoconjugate-based fungicide formulations.	*(6)*

Sec B (33 Marks)

Q. No	Question	Marks
Q1	Discuss in detail the working principles, data interpretation methods, and application domains of the following characterization techniques used for nanomaterials research: XRD, TEM, UV–Vis spectroscopy, SAXS, SSPL, FTIR, and DLS. Your answer must include:	
	1. Fundamental Principle and Instrumentation ○ Explain the working principle. ○ Describe key components of each instrument.	*(7)*
	2. Data Output and Interpretation ○ Explain the type of data obtained: ▪ XRD: crystallite size, lattice parameters, phase identification ▪ TEM: morphology, lattice fringes, SAED ▪ UV–Vis: bandgap, plasmon resonance ▪ STM: surface topography at atomic scale ▪ FTIR: functional groups, bonding ▪ DLS: hydrodynamic size, polydispersity ○ Provide examples of how these data are used in Nanomaterials characterization.	*(12)*
	3. Advantages, Limitations & Complementarily ○ Discuss resolution limits, sample preparation issues, instrument constraints. ○ Explain why multiple techniques must be combined for reliable material characterization.	*(6)*
	4. Case Study/Application to Nanomaterials: Select any nanomaterial (e.g., metal nanoparticles, quantum dots, nanocomposites) and describe how at least **four** of these techniques together help in understanding its completely.	*(8)*

Sec C (33 Marks)

Q. No	Question	Marks
Q1	Discuss in detail the synthesis of nanomaterials using the following methods: solution growth, hydrothermal synthesis, micelle-assisted synthesis, sol–gel method, ball milling, and photolithography. In your answer include:	
	1. Fundamental principle of each method	*(9)*
	2. Reaction mechanisms and process parameters (temperature, pH, pressure, precursor chemistry, templates, milling time, beam exposure)	*(6)*
	3. Advantages, limitations, and scalability	*(6)*
	4. Types of nanomaterials produced (oxide NPs, quantum dots, thin films, nanostructured powders, patterned nanostructures)	*(6)*
	5. Effect of synthesis method on nanomaterial properties (size, morphology, crystallinity, defects, surface chemistry, optical/magnetic properties)	*(6)*