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GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

Ph.D. (Second Semester-Summer) Examinations, May – 2025

23SPPEPH2011 – Multifunctional material Preparation, Properties and their Applications

(Physics)

Time: 3 hrs Maximum: 70 Marks

The figures in the right-hand margin indicate marks.

Answer *ANY FIVE* Questions. (14 x 5 = 70 Marks) **Marks**

1.	Define and list out various methods used on Chemical Vapor Deposition (CVD). Explain in detail the LASER CVD and ALD methods and their working principles with applications.	14
2.a	Write short notes on Langmuir-Blodgett growth and Ball milling method.	7
b.	Compare between Sol-gel and Hydrothermal synthesis method.	7
3.a.	How do multiphase materials balance demands like high conductivity and high porosity? Explain how hierarchical porous structures enhance multifunctionality in sensors and batteries? What role do nanofillers (e.g., carbon nanotubes, graphene) play in enhancing conductivity without increasing density?	7
b.	How can grain size and microstructure control the strength, hardness, and toughness of a material? Define strength and toughness of a material and write its importance to balance both properties in multifunctional materials for construction?	7
4.	Define CNTs and Graphene. Write down its properties and applications. Discuss the role of carbon nanotubes and graphene in improving the mechanical properties of high-strength nano-composites.	14
5.a.	What is a sensor? Compare between fluorescence-based Nano sensors and electrochemical Nano sensors.	7
b.	Define solid electrolyte interface (SEI), and why is it important? Compare between Li ion and Na ion batteries. What are the advantages of lithium-ion batteries compared to other types?	7
6.a.	Define nano materials. Write down its different synthesis procedure. List out various biological and biomedical applications of the nano materials.	7
b.	Define S parameters. Write down its various properties. Why S parameter is required for Microwave applications?	7
7.	Write the working principle behind the open-ended coaxial probe and free space method for investing for EM properties of material with proper diagram and compare between these two. Also provide its advantage and disadvantage of these methods.	14
8.	Define dielectric constant, dielectric loss and dielectric breakdown. Explain how these properties play a crucial role in device design. How does dielectric loss affect signal integrity in high-speed circuits? How does the microstructure (grain boundaries, porosity) affect dielectric performance?	14

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