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**GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR
(GIET UNIVERSITY)**



**Ph.D. (Second Semester-Summer) Examinations, APR – 2026
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

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| 1. | Explain the role of temperature, pressure and catalysts in the hydrothermal process. Also explain the advantage and disadvantage of this process. | 14 |
| 2. | Discuss in detail the various methods used for thin film deposition, with particular emphasis on Chemical Vapor Deposition (CVD) and Physical Vapor Deposition (PVD). Also explain their working principles, advantages, disadvantages, and typical applications. | 14 |
| 3.a | Discuss the advantages of using nanomaterials (like nanoparticles or nanotubes) compared to traditional materials in sensing applications, focusing on the concepts of sensitivity and selectivity. | 7 |
| b | Discuss the role of quantum dots, perovskite materials, and plasmonic nanoparticles in improving light absorption and charge transport in solar cells. | 7 |
| 4. | Write a short-note on dielectric materials and its types, example and applications. Also explain about CNTs and Graphene. | 14 |
| 5.a. | Explain the fundamental physical mechanism behind the size dependence of a material's Electronic Properties as its dimensions approach the nanoscale. | 7 |
| b. | Describe the unique challenges and opportunities presented by the Biological Properties of multifunctional nanomaterials, specifically addressing the concepts of biocompatibility, toxicity, and the role of surface chemistry. | 7 |
| 6.a | Describe how the Vibrational Properties (phonons) differ between bulk and nanomaterials, and explain how techniques like Raman Spectroscopy can be used to study this size dependence. | 7 |
| b. | Describe how the change in the Optical Properties of a quantum dot can be precisely engineered by controlling its synthesis size. Include a sketch illustrating the relationship between particle size and bandgap energy. | 7 |
| 7. | Explain the concept of scattering parameters (S-parameters) and their importance in microwave network analysis and write down various properties of S parameters. | 14 |
| 8. | Define microwave and its frequency range and applications. Explain about microwave absorbing materials with emphasis on magnetic based microwave absorbing materials. | 14 |

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