QPC: R251M024 AR 24 Reg. No

# Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
# (GIET UNIVERSITY)

Ph.D. (First Semester-Summer) Examinations, December - 2025

**23SPPEPH1011 - ADVANCED EXPERIMENTAL TECHNIQUE FOR MATERIALS**

(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.a. | Classify Crystalline defects? Explain their formation, characteristics, and influence on mechanical, electrical, and thermal properties? | 8 |
| b . | Explain the various types of atomic bonding in solids? Discuss with suitable examples, how bond type influences various properties of materials? | 6 |
| 2. | Define edge, screw dislocations, Burgers vectors, and stress fields. Explain their role in plastic deformation and strengthening mechanisms? | 14 |
| 3.a. | Discuss how applied electric field induces polarization in solids. Derive the relation between polarization, susceptibility, and permittivity? | 7 |
| b. | Discuss direct and reverse piezoelectric effects and applications of piezoelectric materials? | 7 |
| 4. | Explain in detail the different polarization mechanisms in dielectric materials: A. Electronic polarization, B. Ionic polarization, C. Dipolar polarization, D. Space charge polarization, Discuss their temperature dependence? | 14 |
| 5.a. | Describe the complex refractive index. Explain its real and imaginary components, absorption coefficient, and attenuation of electromagnetic waves in matter? | 7 |
| b. | Explain different light scattering mechanisms in materials: A. Rayleigh scattering, B. Mie scattering, C. Raman scattering | 7 |
| 6.a. | Discuss Atomization and detector. Describe how Atomic Absorption Spectroscopy is used for compositional analysis? | 7 |
| b. | Compare Atomic Emission Spectroscopy (AES) and Atomic Fluorescence Spectrometry (AFS) with respect to Principle, Sensitivity, Instrumentation and Detection limits? | 7 |
| 7. | Describe the working principle of TEM. Explain electron diffraction, bright-field & dark-field imaging, and high-resolution TEM (HRTEM)? | 14 |
| 8.a. | Explain the principles of X-ray diffraction (XRD) based on interaction of X-rays with crystal planes. Derive Bragg's law and discuss diffraction conditions? | 7 |
| b. | Discuss different types of characterization techniques used in material testing? | 7 |

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