**Government College for Women, Bawani Khera (Bhiwani)**

**Department of Physics**

**Academic Year: 2023-24**

Paper Title: **Nanomaterials and Applications (20UPHY 601B)**

**Marks Allotted: 50**

**External Examination: 40**

**Internal Assessment: 10**

**Objective of Teaching the Paper:** Upon successful completion, students will have the knowledge and skills to:

1. Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
2. Apply engineering and physics concepts to the nano-scale and non-continuum domain.
3. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature.
4. Design processing conditions to engineer functional nanomaterials.
5. Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.
6. Apply and transfer interdisciplinary systems engineering approaches to the field of bioand nanotechnology projects.
7. Discuss and evaluate state-of-the-art characterization methods for nanomaterials, and determine nanomaterial safety and handling methods required during characterization.

Mode of Transaction for the Paper:

* Lectures
* Discussion
* Assignments

**Readings:**

Essential Readings:

1. Nanotechnology - An introduction J.J. Ramsden William Andrew Elsevier
2. Introduction to Nanotechnology C.P. Polle Jr. & F.J. Owens – John Wiley and sons.

Paper Title: **Atomic and molecular spectroscopy (20UPHY 602A)**

**Marks Allotted: 50**

**External Examination: 40**

**Internal Assessment: 10**

**Objective of Teaching the Paper:** Upon successful completion, Students will be the able to:

1. describe the atomic spectra of one and two valance electron atoms.

2. explain the change in behavior of atoms in external applied electric and magnetic

field.

3. explain rotational, vibrational, electronic and Raman spectra of molecules.

4. Describe electron spin and nuclear magnetic resonance spectroscopy and their applications.

Mode of Transaction for the Paper:

* Lectures
* Discussion
* Assignments

**Readings:**

Essential Readings:

1. Introduction to : Atomic and molecular spectroscopy by V.K. Jain, Nasora (2007).
2. Introduction to Atomic spectra by H.B. White.
3. Atomic spectra by G. Herzberg.
4. Fundamental of molecular spectroscopy by Colin N. Benwell, Elaine M.Mc-cash.

**Teaching Plan for the Academic session 2023-24**

**B.Sc. 3rd Year, Semester 6th**

**Teacher:**

**Dr. Pawan Kumar Assistant Professor, Physics,** [**pawansaroha500@gmail.com**](mailto:pawansaroha500@gmail.com)

**Contact: +91-9466580255**

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| **Lesson Plan for The Month Feb 2024 to May 2024** | **Subject: Nanomaterials and Applications & Atomic and molecular spectroscopy** |
| **Name Of the Teacher : Dr. Pawan Kumar** | **Class : BSc 6th Sem** |
| 01-02-2024 To 03-02-  2024 | Basic Idea of Band Structure, Metals, Insulators |
| 05-02-2024 To 10-02-  2024 | Variation of Density of states and band gap with size of crystal, Quantum Confinement, electron confinement in one, two and three dimensional infinitely deep square well potentials |
| 12-02-2024 To 17-02-  2024 | Well Potentials, Quantum Well, wire and dot (Basic idea), Bottom up and down approaches for synthesis of nanomaterials, sol-gel process, core-shell nanomaterials, ball milling |
| 19-02-2024 To 23-02-  2024 | Chemical vapour deposition techniques, Lithography: Two dimensional nanostructures, Carbon Molecules, New carbon structures |
| 26-02-2024 To 02-03-  2024 | Carbon Clusters: C60 and other bucky balls, Structure of C60 and Larger fullerenes, Graphene, Carbon Nanotubes, Fabrication techniques, Structural Properties: Electrical Properties, Vibrational properties and Mechanical properties |
| 04-03-2024 To 09-03-  2024 | Applications of carbon nanotubes, Basic principles and idea of instrumentation for characterization of nanostructures: X-ray diffraction techniques, |
| 11-03-2024 To 16-03-  2024 | Transmission electron microscopy, Raman spectroscopy, Atomic force microscopy, scanning tunneling microscopy, Assignment 1 and Unit Test |
| 18-03-2024 To 22-03-  2024 | Atomic spectra, Bhor atomic model, Energy levels and spectra, correspondence principle, atomic excitation, Frank Hertz experiment, vector atom model, quantum numbers associate with vector atom model, |
| 23-03-2024 To 31-03-  2024 | **Break (Holi)** |
| 01-04-2024 To 06-04-  2024 | penetration and non-penetrating orbits (quantities description), Spectral lines in different series of alkali spectra, spin orbit interaction and doublet orbit separation, LS or Russel sounder coupling, JJ coupling |
| 08-04-2024 To 12-04-  2024 | Zeeman effect (Normal and Anomalous), Zeeman pattern, Paschen back effect of a single valance electron system, Stark effect, discrete set of electronics energies of molecules, |
| 15-04-2024 To 20-04-  2024 | Quantization of vibration and rotational energy, Raman effect, Stoke’s and Anti-Stoke’s lines, Main features of a laser: directionality and high intensity, high degree of coherence |
| 22-04-2024 To 27-04-  2024 | Spatial and temporal coherence, Einstein’s coefficients and possibility of amplification, Threshold condition for laser emission, |
| 29-04-2024 To 30-04-  2024 | Laser pumping, He-Ni laser and Ruby laser, Assignment 2 and unit test. |

Dr. Pawan Kumar

Assistant Professor in Physics

GCW Bawani Khera