

ADIKAVI NANNAYA UNIVERSITY :: RAJAHMUNDRY

DEPARTMENT OF PHYSICS

Pre-PhD Course work syllabus – (w.e.f. 2019)²²

Paper I: Recent Advances in Physical Sciences and Research Methodology

Unit-I: Introduction and Types of Research Studies

Meaning and objectives of research, motivation and dedication in research, criteria of good research, ethics in research, plagiarism, scientific integrity, selecting a topic, importance of planning, planning experimentation, field work and accessing advanced facilities. Define Library Research, Field Research and Laboratory Research; Explain Sample Survey, Sample Collection and/or Preparation, Data Analyses, Hypothesis, Modeling, Interpretation, and Conclusion

Unit-II: Literature Review

Journals: Standard journals in Physical Sciences, Impact factor, Citations, web based journals, Journal Metrics, Citations, h- index, writing a research paper, popular websites for scientific literature, choosing journal for sending research publications, styles of writing references. Search engines like Science Direct, Web of Science, Indian Citation Index and Google Scholar.

Unit III: Intellectual Property rights

Introduction to Intellectual Property Law-Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory - Overuse or Misuse of Intellectual Property Rights –Compliance and Liability Issues. Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters. Introduction to Trademark – Trademark Registration Process – Post registration procedures – Trademark maintenance – Transfer of rights – Inter parties Proceedings – Litigations in Trademark.

Unit-IV: Research Ethics and Plagiarism

Research Ethics and Plagiarism: Rules and guidelines for research publications -Code of Research ethics, Authorship guidelines- Plagiarism policies of UGC and its software information – Information on UGC Care journals list.

Unit V: Preparation of Thesis:

Structure of thesis, background of the work, importance of language, grammar, scientific and systematic way of presentation, statistical analysis, use of graphical representation, proper preparation of graphs and tables, discussion, comparison with previous work, interpretation of results, summery and conclusions.

References:

1. Blum, Deborah and Mary Knudson, eds. A field guide for science writers: the official guide of the National Association of Science Writers, New York: Oxford University Press, 1997.
2. Booth, Wayne, Gregory G Colombo, Joseph M. Williams. The craft of Research Chicago University of Chicago Press, 1995.
3. Davis, Martha. Scientific Papers and Presentations. San Diego: Academic Press, 1997.

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Model Question Paper

ADIKAVI NANNAYA UNIVERSITY :: RAJAHMUNDRY
DEPARTMENT OF PHYSICS
Pre-PhD Examination - 2022

Paper I: Recent Advances in Physical Sciences and Research Methodology

Time: 3 Hours

Max Marks: 100 M

Answer all the questions
Each question carried 20 marks

1. Define Research and explain the objectives criteria of good research and ethics in research.

OR

Describe various types of research and explain sample survey, preparation, collection and data analysis.

2. What are the standard journals in physical sciences? Explain their impact factor and citations.

OR

Explain how to choose a journal for sending research publications. Briefly explain about search engine like science direct and Indian citation index.

3. What is an intellectual property law and explain the basic types, inventions and innovations in intellectual property rights?

OR

Describe Patent law, rights under patent law, application process, granting of patent and new developments in patent law.

4. Describe the plagiarism rules and guidelines for research publications and code of research ethics.

OR

Write about the plagiarism policies of UGC and explain its software information.

5. Explain the structure of thesis, importance of the language scientific and systematic presentation.

OR

Explain the statistical analysis and preparation of graphs and tables and explain how do you interpret the results and write the conclusions.

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DEPARTMENT OF PHYSICS
Pre-PhD Course work syllabus – (w.e.f. 2022)
NANOSCIENCE AND ITS APPLICATIONS (Mr. P. Tirupathi Rao)

Unit 1: Fundamentals of Nanoscience and technology

Introduction and emergence of Nanotechnology, Bottom up and Top down approaches, challenges in nanotechnology: Introduction to Quantum wells, Quantum wires and Quantum dots; Introduction to solid state physics – structures and energy bands; Introduction to physical, Electrical, Mechanical and other properties of Nanomaterials.

Unit 2: Synthesis of Nanomaterials

Types and strategies for synthesis of Nanomaterials depending on end applications, Zero – Dimensional Nanostructures: Nanoparticles: Introduction, different strategies for synthesis of these Nanomaterials and their technological applications: One- Dimensional Nanostructures: Nanorods and Nanowires: Introduction, different strategies for synthesis of 1D Nanomaterials and their technological applications: Two –Dimensional Nano structures. Thin film: Introduction, different strategies for synthesis of 2D Nanomaterials and their technological applications: Special Nanomaterials and applications: Introduction, different strategies for synthesis of special Nanomaterials (e.g. carbon, micro and mesoporous, zeolites, core-shell structures, hybrid Nanomaterials, nanocomposites etc) and their technological applications.

Unit 3: Characterization of Nanomaterials

Introduction, structural characterisation, X-ray diffraction (XRD powder / single crystal). Small angle X-ray scattering (SAXS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Scanning Probe Microscopy (SPM)- principle of operation, instrumentation and probes, Atomic force microscopy (AFM). Optional spectroscopy, luminescence spectroscopy, UV-vis spectroscopy (liquid and solid state). Infrared spectroscopy. Raman spectroscopy, X- ray photoelectric spectroscopy (XPS), Energy Dispersive X-ray spectroscopy (EDS), Auger electron spectroscopy (AES).

Unit 4: Fabrication of Nanomaterials

Top-Down Approach-Planetary ball milling: Bottom-up approach (Wet chemicals synthesis method). Microemulsion approach. Aerosol synthesis, Spray pyrolysis, electro chemical deposition, Gas phase production Methods: Physical and chemical vapour deposition techniques, Atomic layer deposition.

Unit 5: Applications of nanotechnology in various fields

Medicine, Biology, Electronics and communication systems, Optics, Agriculture, Food, Renewable energy, Solar energy, Fuel cells, Solar cells, Batteries, Defence, Aerospace, Marine, Fuels, Coolants and Lubricants, Sensors, Sporting goods and fabric.

References:

1. Charles P, Poole. Jr.& Frank J.owens, Introduction to Nano technology- John wiley& sons Inc.Publishers-2006.
2. Guozhong Cao Nanostructures and Nanomaterials, Synthesis, Properties and applications- Imperial College press.
3. T.Pradeep, "NANO: The Essentials, Understanding Nanoscience and Nanotechnology",Tata McGraw-Hill Publishing Company Limited 2007.

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P. Kamachandra Rao
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Dr. KAMACHANDRA RAO. K, Ph.D.
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Model Question Paper

ADIKAVI NANNAYA UNIVERSITY :: RAJAHMUNDRY
DEPARTMENT OF PHYSICS
Pre-PhD Examination – 2022

Paper II: Nanoscience and its Applications (Mr. P. Tirupathi Rao)

Time: 3 Hours

Max Marks: 100 M

Answer all the questions
Each question carried 20 marks

1. Explain about nanotechnology and bottom up and top down approaches and challenges in nanotechnology.

OR

Describe various Quantum structures and properties of Nanomaterials.

2. Classify Nanomaterials based on dimensionality and their synthesis.

OR

Explain Special Nanomaterials, their synthesis and technological applications.

3. Describe Structural Characterisations- X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM).

OR

Describe Optical Spectroscopy, Luminescence Spectroscopy, UV-Vis Spectroscopy, Infrared spectroscopy.

4. Briefly explain planetary ball milling method, wet chemical synthesis method and electro chemical deposition.

OR

Describe Gas phase production method and vapour deposition techniques.

5. Explain at what extent nanotechnology is being useful in Medicine, Biology, Electronics and Communication systems.

OR

Describe various applications of nanotechnology to Optics, Solar cells, Batteries, Sensors and Lubricants.

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P. Tirupathi Rao

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Dr. Ramachandra Rao
Dr. RAMACHANDRA RAO, K, Ph.D.
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ADIKAVI NANNAYA UNIVERSITY :: RAJAHMUNDRY

DEPARTMENT OF PHYSICS

Pre-PhD Course work syllabus (w.e.f. 2019)

Paper-II: ATOMIC AND MOLECULAR MODELING FOR SPECTROSCOPIC APPLICATIONS (Mr. Dharmarpu Vijay)

Unit - I: Experimental methods and Instrumentation

Electromagnetic spectrum, General components of absorption experiment, Fourier transformation and interferometers, Infrared (IR), Visible and Ultra-Violet (UV-Vis) radiation. Components of absorption experiments in the regions of far Infrared, Near Infrared (Near-IR) and Mid Infrared (Mid-IR), Visible and Near Ultra-Violet, Raman Spectroscopy, Synchrotron Radiation Source (SRS).

Unit - II: A Quantum Mechanical Model for the Vibration and Rotation of Molecules

Symmetry Elements, Symmetry Operations and Point Groups, Assigning Molecules to Point Groups, Absorption, Spontaneous Emission, and Stimulated Emission, The Origin of Selection Rules, The H₂O Molecule and the C_{2v} Point Group, The Symmetries of the Normal Modes of Vibration of Molecules, Spectral activity, Group vibrations, Normal vibrations of non – degenerate and degenerate systems, Vibrational selection rules for Infrared and Raman spectra, Vibration – Rotation spectroscopy of linear molecules.

Unit – III: Molecular Quantum Mechanics

Molecular structure, many electron atoms, Self-consistent fields (SCF), Born – Oppenheimer approximation, Molecular Orbital theory, Linear combination of atomic orbitals, Hydrogen molecule configuration interaction, Diatomic molecules, Molecular orbital theory of poly atomic molecules, Symmetry adopted linear combination, Calculation of electronic structure.

Unit - IV: Molecular Electronic Structure Methods

Introduction to molecular electronic structure, Ab-Initio Methods, Ab Initio Molecular Dynamics, Applications of Ab Initio Molecular Dynamics, semi empirical methods, Hartree Fock's self-consistent field method, Restricted and unrestricted Hartree Fock calculations, Properties of Limiting Hartree-Fock Models, The Molecular Potential Energy Surface, Selection of basis sets, Electron correlation, Configuration interaction.

Unit – V: Theoretical Modeling Methods

Density Functional Theory methods, Molecular geometry, Visualization and optimization of structure, Thermodynamic properties, Molecular vibrational frequencies, Mulliken atomic charge distributions, Computational programs: Performing Ab-Initio calculations with Gaussian, Gaussian Basis Sets, Selection of a Theoretical Model, Vibrational Energy Distribution Analysis (VEDA) Program, The Natural Bond Orbital (NBO) program NBO 7.0, Molecular Electrostatic Potential (MEP) analysis.

Text/Reference books:

1. Vibrational spectroscopy theory and applications by D.N.Satyanarayana(New Age International publishers).
2. Molecular Quantum mechanics by P.W.Atkins and R.S.Friedman(Oxford University press).
3. Quantum Chemistry by IRA N.LEVINE VI edition 2009(Printice Hall India).
4. Molecular Modelling for Beginners Second Edition ALAN HINCHLIFFE The University of Manchester A John, This edition first published 2008 JohnWiley & Sons Ltd.

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Model Question Paper
ADIKAVI NANNAYA UNIVERSITY:: RAJAHMUNDRY
DEPARTMENT OF PHYSICS
Pre-PhD Examination : 2022
Paper-II: ATOMIC AND MOLECULAR MODELING FOR
SPECTROSCOPIC APPLICATIONS (Mr. Dharmarpu Vijay)

Time: 3 Hours

Max. Marks: 100 M

Answer all the questions
Each question carried 20 marks

1. Discuss the advantages of Fourier transformation in interferometry. Describe the construction and working of Fourier transform infrared spectrometer

OR

Discuss different regions of the electromagnetic spectrum. Explain the working of a single beam atomic absorption spectrometer and discuss how the measurements and results are obtained.

2. Explain the concept of emission and absorption spectra. Discuss the Origin of Selection Rules and Infrared Absorption Spectroscopy

OR

Explain the group vibrations. Discuss the Vibration – Rotation spectroscopy of linear molecules and Raman Rotational Spectroscopy.

3. Explain Born – Oppenheimer approximation for molecular system. Discuss the theory and success of Hartree Fock self-consistent field method for molecules.

OR

Explain Molecular Orbital theory. Discuss the linear combination of atomic orbitals and Hydrogen molecule configuration interaction.

4. Explain Hartree Fock's self-consistent field method. Discuss the properties of Limiting Hartree–Fock Models, Restricted and unrestricted Hartree Fock calculations.

OR

Explain Ab-Initio Methods. Discuss the Ab Initio Molecular Dynamics and Applications of Molecular Dynamics.

5. Explain the salient features of Density Functional Theory. State and prove fundamental theorems of Density Functional Theory. Discuss the applications, merits and demerits of Density Functional Theory.

OR

Explain the salient features of Gaussian. Discuss the different basis sets and methods available in advanced version.

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ADIKAVI NANNAYA UNIVERSITY: RAJAHMUNDRY

Department of Physics

Pre Ph.D. Examination syllabus (w.e.f 2019)²²

Paper: II Nanoscience and Experimental characterization (w.e.f 2019)²²
(G.ManiRatnam)

Unit I

Fundamentals of Nanoscience and technology: Introduction and emergence of Nanotechnology, Bottom up and Top down approaches, challenges in nanotechnology: Introduction to Quantum wells, Quantum wires and Quantum dots; Introduction to solid state physics – structures and energy bands ; Introduction to physical, Electrical , Mechanical other properties.

Unit II

Synthesis of Nanomaterials: Dimensional Nanostructures: Nanoparticles: Introduction, different strategies for synthesis of these Nanomaterials and their technological applications: One- Dimensional Nanostructures: Nanorods and Nanowires: Introduction, different strategies for synthesis of 1D Nanomaterials and their technological applications: Two –Dimensional Nano structures. Thin film: Introduction, different strategies for synthesis of 2D Nanomaterials and their technological applications: Special Nanomaterials and applications: Introduction, different strategies for synthesis of special Nanomaterials (e.g. carbon, micro and mesoporous , zeolites, core-shell structures, hybrid Nanomaterials, nanocomposites etc) and their technological applications.

Unit III

Characterization of Materials: Introduction to structural characterisation, Diffraction Techniques (XRD powder / single crystal). Small angle X-ray scattering(SAXS), scanning electron microscopy (SEM), transmission electron microscopy(TEM), Resonance Techniques (ESR and Mossbauer) – Spectroscopic Techniques (Laser Raman , FTIR, UV (Liquid and solid) - X- ray photoelectric spectroscopy (XPS), Energy Dispersive X-ray spectroscopy(EDS), Auger electron spectroscopy(AES).

Unit IV

Fabrication of Nanomaterials: Top Down approach-Planetary ball milling: Bottom up approach (Wet chemicals synthesis method). Microemulsion approach.Aerosol synthesis, Preparation of ferrites and glass Materials –Spray pyrolysis, electro chemical deposition, Atomic layer deposition, Pervoskite solar cells, preparation methods.

Unit V

Applications of nanotechnology in various fields: Medicine, Biology, Electronics and communication systems, Optics, Agriculture, Food, Renewable energy, Solar energy, Fuel cells, Solar cells, Batteries, Defence, Aerospace, Marine, Fuels, Coolants and Lubricants,Sensors, Sporting goods and fabric.

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3. T.Pradeep, "NANO: The Essentials, Understanding Nanoscience and Nanotechnology",Tata McGraw- Hill Publishing Company Limited 2007.
4. Solar cells,M.Markvat and Luis Castaner ,Elasverpublications

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Pre PhD Examination Model Question Paper

Paper: II Nanoscience and Experimental characterization
(G.Mani Ratnam, w.e.f 2019)

22

Time: 3hours

Max Marks -100

SECTION-A

Answer all questions
Each carried 20 marks

Answer the Following

5×20=100M

1. Explain about nanotechnology and bottom up and top down approaches and challenges in nanotechnology.

OR

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OR

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3. Describe Structural Characterisations- X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM).

OR

Describe Laser Raman spectroscopy, UV-Vis Spectroscopy, Infrared spectroscopy (FTIR).

4. Briefly explain planetary ball milling method, wet chemical synthesis method and electro chemical deposition.

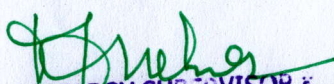
OR

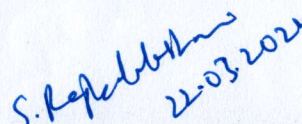
Discuss the efficiency of perovskite solar cell and Explain the different preparation methods

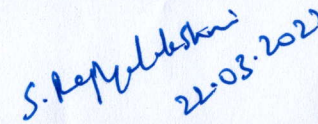
5. Biology, Electronics and Communication systems.

OR

Describe various applications of nanotechnology to Optics, Batteries, Sensors and Lubricants.


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Department of Physics
Pre Ph.D. Examination syllabus (w.e.f 2019)

Paper: II Nanoscience and Experimental characterization (w.e.f 2019)
(P.Mohan Kumar)

Unit I

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Unit V

Applications of nanotechnology in various fields: Medicine, Biology, Electronics and communication systems, Optics, Agriculture, Food, Renewable energy, Solar energy, Fuel cells, Solar cells, Batteries, Defence, Aerospace, Marine, Fuels, Coolants and Lubricants,Sensors, Sporting goods and fabric.

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Pre PhD Examination Model Question Paper

Paper: II Nanoscience and Experimental characterization

(P.Mohan Kumar, w.e.f 2019)

22

Time: 3hours

Max Marks -100

SECTION-A

Answer all questions

Each carried 20 marks

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Describe Laser Raman spectroscopy, UV-Vis Spectroscopy, Infrared spectroscopy(FTIR).

4. Briefly explain planetary ball milling method, wet chemical synthesis method and electro chemical deposition.

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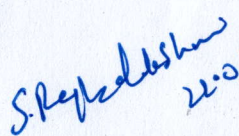
Discuss the efficiency of perovskite solar cell and Explain the different preparation methods

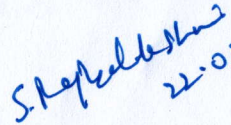
5. Biology, Electronics and Communication systems.

OR

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