



# **DOCTOR OF PHILOSOPHY - PHYSICS**

**Syllabus and Scheme**

## **DEPARTMENT OF PHYSICS**

**SCHOOL OF BASIC SCIENCES**

**ABHILASHI UNIVERSITY  
CHAIL CHOWK, TEH. CHACHYOT,  
DISTT. MANDI-175045, HP, INDIA**

# PROGRAMME STRUCTURE

## Ph.D. PHYSICS

S.No.	Course Code	Course Title	Theory	Seminar	Practical
1.	AUPHY-601	Advanced Nano Physics	4	0	0
2.	AUPHY-602	Advanced Material Science	4	0	0
3.	AUPHY-603	Research Methodology	4	0	0
4.	AUPHY-604	Research Publication and Ethics	2	0	0
6*.	AUPHY-606	Dissertation	0	1	0

**Total credits :12**

## AUPHY-601 : Advanced Nano Physics

L+T+P	:	<b>4+0+0</b>	Mid Sessional exam	:	<b>30</b>
Credits:	:	<b>4</b>	Quiz +Assignment	:	<b>10</b>
Contact hours	:	<b>56</b>	End-semester exam	:	<b>60</b>

Unit	Contents	Lectures
<b>I</b>	Introduction: Definition, historical perspective, effects of nanoscience and nanotechnology on various fields; Classification of nano-structured materials, top down and bottom up approaches of generation; Properties of nano-structured materials; Size and shape dependent properties, color, melting point, magnetism, density of states, conductivity and band gap, metal to insulator transition.	11
<b>II</b>	Fundamental behavior of 0-D, 1-D, 2-D, and 3-D materials. Introduction to size dependent phenomenon in nanostructure for various application, specific production techniques like chemical vapor deposition, arc ignition etc. Formation of clusters and nanoparticles from supersaturated vapor and selected properties, sputtering and thermal evaporation and laser methods. Synthesis of nanoparticles by chemical routes.	10
<b>III</b>	Quantum Wells, Wires, and Dots: Introduction; Preparation of Quantum Nanostructures; Size and Dimensionality effects: size effect, conduction electrons and dimensionality, Fermi gas and Density of States, Potential wells, Partial confinement, properties dependent and density of states.	10
<b>IV</b>	Types of Nanomaterials and Their Properties: Chemical Properties: The effect of nanoscale metals on chemical reactivity, effect of nanostructure on mass transport, metal nanocrystallites supported on oxides, supported nanoscale catalysts. Optical Properties of Semiconductor Nanoparticles; Plasmonic Materials, Localized Surface Plasmon Resonance, Surface Plasmon Polariton.	12
<b>V</b>	Electronic transport from classical kinetic theory, calculation of relaxation time in metals and insulators, Hall effect and magnetoresistance, magnetic flux, magnetization, magnetic induction, susceptibility and permeability, diamagnetism and diamagnetic susceptibility, Paramagnetism, Curie law and Curie-Weiss law, Pauli paramagnetism, Ferromagnetism, hysteresis, magnons, domain theory, ferri-magnetism, anti-ferromagnetism	13

S. No.	Reference Books
<b>1</b>	Nanotechnology: Principles and Practices: Sulabha K Kulkarni, Springer: Capital rd Publishing company, 3 ed., 2014.
<b>2</b>	Introduction to nanotechnology: Charles P Poole Jr., Frank J Owens, John Wiley and Sons, 2003.
<b>3</b>	Nanoscience and Nanotechnology: M S Ramachandra Rao, Shubra Singh, Wiley India, 2013.
<b>4</b>	Nanostructured Materials: Wei, Ying, Y Jackie, Academic Press Inc. New York, 2001.
<b>5</b>	Nanotechnology- Molecularly Designed Materials: GM Chow, KE Gonsalves, American Chemical Society, 1996.
<b>6</b>	Nanoparticles and Nanostructured Films–Preparation, Characterization and Application: JHFendler, Wiley, 1998.
<b>7</b>	Physics of Low-Dimension Semiconductors: JH Davies, Cambridge Univ. Press, 1998.

## AUPHY-602 : Advanced Materials Science

L+T+P	:	<b>4+0+0</b>	Mid Sessional exam	:	<b>30</b>
Credits:	:	<b>4</b>	Quiz +Assignment	:	<b>10</b>
Contact hours	:	<b>56</b>	End-semester exam	:	<b>60</b>

Unit	Contents	Lectures
<b>I</b>	Introduction to material: Non-crystalline and crystalline solids, unit cell, space lattice, Bravais lattice, crystal systems, Miller indices, Indices of lattice directions and planes, coordinates of position in the unit cell, zones and zone axes, crystal geometry, symmetry classes and point groups, space groups, glide planes and screw axes, space group notations, equivalent points, systematic absences	11
<b>II</b>	Phase transitions, magnetic materials, high $T_c$ superconductors, alloys & composites, semiconductors, solar energy materials, advanced biomaterials, imperfection in a crystal, points defects, line defects, dislocations	6
<b>III</b>	Preparation of materials by different techniques: Single crystal growth, zone refining, epitaxial growth, melt- spinning and quenching methods, sol-gel, polymer processing, Co-precipitation method. Preparation of ceramic materials; fabrication, control and growth modes of organic and inorganic thin films: different technique of thin film preparations: basic principles.	11
<b>IV</b>	Synthesis of nanomaterials: Top down and bottom up approaches of synthesis of nano-structured materials, Mechanical attrition, high energy ball milling, and mechanical attrition, nanocomposites by mechano-chemistry, mechanism of grain size reduction, property of microstructure relationships, Advanced methods of coatings and nanofilms deposition, advanced materials in 3D printing	12
<b>V</b>	Vacuum Techniques: Simple description and working principle of vacuum pumps (Rotary, Diffusion and Turbo-molecular), Penning and Pirani gauges, leak detection techniques.	4
<b>VI</b>	Materials Characterization Techniques: X-ray Diffraction (XRD), X-ray Spectroscopy (XPS), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Infrared (IR) spectroscopy, Ultraviolet-Visible (UV-Vis) Spectroscopy, Dielectric Spectroscopy, Physical property measurements (DSC, DTA, TGA), Mössbauer Spectroscopy, Vibrating Sample Magnetometer (VSM), Superconducting Quantum Interference Device (SQUID).	12

S. No.	Reference Books
<b>1</b>	Materials science and Engineering by V. Raghavan, Prentice-Hall Pvt. Ltd.
<b>2</b>	Thin Solid Films by K. L Chopra
<b>3</b>	Elements of X-ray diffraction by B. D. Cullity, Addison-Wesley Publishing Co.
<b>4</b>	Elements of crystallography by M. A. Azaroff
<b>5</b>	Engineering Materials by Kenneth G. Budinski, Prentice-Hall of India Pvt. Ltd.
<b>6</b>	Materials Characterization Techniques: Sam Zhang, Lin Li, Ashok Kumar

## AUPHY-603 : Research Methodology

L+T+P	:	<b>4+0+0</b>	Mid Sessional exam	:	<b>30</b>
Credits:	:	<b>4</b>	Quiz +Assignment	:	<b>10</b>
Credit hours	:	<b>42</b>	End-semester exam	:	<b>60</b>

Unit*	Contents	Lectures
<b>I</b>	History, myths and ethnic practices; need, importance and impact of research; types of research; research process.	3
<b>II</b>	Synopsis writing: Selecting research problem; formulation of research projects; survey of literature; research infrastructure; experimental designs; sampling designs; recording of observations ; measurement and scaling techniques; GLPs.	4
<b>III</b>	Formulation and types of hypothesis; collection, maintenance, storage and analysis of data; measures of central tendencies and relationships and error analysis; tests of significance.	6
<b>IV</b>	Compilation and presentation of results, Writing of manuscripts; research reports and thesis; organization of reference material using endnote; bibliography; plagiarism; IPR and patent application, entrepreneurship.	6
<b>V</b>	Financial support and various funding agencies; Multidisciplinary and multi-institutional research; writing research proposal for external funding.	3
<b>VI</b>	Computer and informatics; introduction; word processing, excel, power point presentation; graph and figure plotting; web browsing; information resources and various databases.	6
<b>VII</b>	Demonstration of departmental research activities and instrumentation	7
<b>VIII</b>	Writing a review article on topic of interest or suggested by research committee	7

S. No.	Reference Books
1.	Research Methodology-Methods and Techniques: C R Kothari, New Age International, 2 <sup>nd</sup> ed., 2004.
2.	Research Methodology: A Step by Step Guide for Beginners: R Kumar, Pearson Education, 2 <sup>nd</sup> ed., 2005.
3.	Research Methodology in the Medical and Biological Sciences: P Laake, H Benestad, B Olsen, Elsevier, 1 <sup>st</sup> ed., 2007.
4.	Research Methodology: C Murthy, Vrinda Publications, 1 <sup>st</sup> ed., 2009.
5.	Research Methodology For Biological Sciences: N Gurumani, MJP Publishers, 1 <sup>st</sup> ed., 2013.

## **AUPHY-604 : Research And Publication Ethics**

L +T + P 2+0+0

Credits 2

Credits hrs 2

### **Theory & Practice**

#### **Unit-I Philosophy and Ethics**

Introduction to philosophy: Definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgments and reactions. Publication Misconduct: Group discussions: subject specific ethical issues, FFP, authorship, conflicts of interest, complaints and appeals: example and fraud from India and abroad

#### **Unit-II Scientific misconduct**

Ethics with respect to science and research; Intellectual honesty and research integrity; scientific misconducts: falsification, fabrication, and plagiarism (FFP); redundant publications: duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data. Software tools: Use of plagiarism software like Turnitin, Urkund, and other open access software tools.

#### **Unit-III Publication Ethics**

Definition, introduction and importance, Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest; publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types; violation of publication ethics, authorship and contributorship; identification of publication misconduct, complaints and appeals; Predatory publishers and journals. Databases and Research Metrics: Databases: Indexing databases, Citation databases, web of science, Scopus, etc.

#### **Unit-IV Open access publications**

Open access publications and initiatives; SHERPA/RoMEO online resources to check to check publisher copyright & self-archiving Policies; Software tool to identify predatory publications developed by SPPU; Journal finder/ journal suggestion tools viz. UGC care listed journal, Elsevier Suggested journal finder, Springer journal suggester, Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score; Metrics: h-Index, g- Index, i-10 index, Publons, Google Scholar etc.

## References

Bird, A. (2006). *Philosophy of Science*. Routledge.  
MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.  
P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865  
National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.  
Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>  
Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>  
Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance*(2019), ISBN:978-81-939482-1-7. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

## Useful websites

1. <https://shodhganga.inflibnet.ac.in/handle/10603/203204?mode=full>
2. <https://shodhgangotri.inflibnet.ac.in/>
3. <https://link.springer.com/>
4. <https://link.springer.com/books/a/1>
5. <https://www.elsevier.com/books-and-journals/elsevier>

<https://www.emeraldgrouppublishing.com/our-services/authors/research-publishing-ethics>

## AUPHY-605 : Dissertation

L:T:P: : 0+0+80  
Credits: : 80

Description
Dissertation will carry marks for continuous assessment, dissertation write-up, its presentation and viva-voce. This will be evaluated at the end of each semester.
Students will work on a research topic assigned to him/her by their supervisor/mentor with a purpose to

develop a collective approach to study, analyze and solve the problem. Students are required to collect, analyze the data and submit their dissertation.

<b>Suggested Journals</b>			
<b>S. No.</b>	<b>Name of the research journal/database</b>	<b>Publisher</b>	<b>Website</b>
1.	Journal of Applied Physics	AIP Publication	<a href="http://scitation.aip.org/content/aip/journal/jap">http://scitation.aip.org/content/aip/journal/jap</a>
2.	Applied Physics Letters	AIP Publication	<a href="http://scitation.aip.org/content/aip/journal/apl">http://scitation.aip.org/content/aip/journal/apl</a>
4.	Physical Review B	APS Publication	<a href="https://journals.aps.org/prb/">https://journals.aps.org/prb/</a>
5.	Physical Review Letters	APS Publication	<a href="http://journals.aps.org/prl/">http://journals.aps.org/prl/</a>
6.	Journal of Magnetism and Magnetic Materials	Elsevier Publication	<a href="http://www.journals.elsevier.com/journal-of-magnetism-and-magnetic-materials/">http://www.journals.elsevier.com/journal-of-magnetism-and-magnetic-materials/</a>
7.	Journal of Alloys and Compounds	Elsevier Publication	<a href="http://www.journals.elsevier.com/journal-of-alloys-and-compounds/">http://www.journals.elsevier.com/journal-of-alloys-and-compounds/</a>
8.	Current Applied Physics	Elsevier Publication	<a href="http://www.journals.elsevier.com/current-applied-physics/">http://www.journals.elsevier.com/current-applied-physics/</a>
9.	Journal of Superconductivity and Novel Magnetism	Springer Publication	<a href="http://www.springer.com/materials/journal/10948">http://www.springer.com/materials/journal/10948</a>

### Databases

Scopus, UGC Care list, Google Scholar, Research Gate: Elsevier/Science Direct, Springer Link, AIP, APS etc.