

P.G. DEPARTMENT OF APPLIED PHYSICS AND BALLISTICS

SYLLABUS FOR THE COURSE IN M.PHIL IN PHYSICS (SFC MODE)

FOR THE SESSION 2021-22 (REVISED)



F.M. UNIVERSITY, BALASORE

M.PHIL. PHYSICS
SYLLABUS 2021-2022

P.G. Department of Applied Physics and Ballistics

Approved by BOS on Dt. 23.11.2021

(SFC MODE)

M.Phil. in Physics		
Semester	Marks	Credit
1 st semester	300	24
2 nd semester	300	24
Total	600	48

M.Phil. in Physics			
<u>First Semester</u>			
Code	Name	Int +End Term Mark	Credit
PHY-501	Research Methodology & Computer Application	40+60=100	08
PHY-502	Advance Theoretical Physics	40+60=100	08
PHY-503	Research and Publication Ethics (RPE)	20+30=50	02
PHY-504	Advance Practical	50	06
	Total	300	24

<u>Second Semester</u>			
Code	Name	Mark	Credit
PHY-601	Review/proposal submission for project	50	04
PHY-602	Pre-M.Phil. presentation	50	04
PHY-603	Dissertation Presentation & Grand viva	200	16
	Total	300	24

PROGRAM OUTCOMES (POs)

After completing M.Phil. Program, students will

- ❖ able to identify, formulate, review research literature, and analyse complex problems reaching substantiated conclusions using first principles.
- ❖ be aware of recent research trends, higher education and entrepreneurial opportunities in physical sciences, and will work ethically towards society.
- ❖ be in a position to work in a group and publish their work in reputed journals.
- ❖ be in a position to design and test C/FORTRAN programs for various applications.
- ❖ develop skills to learn new technology and equip themselves with analytic, problem-solving and experimental skills.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After completing M.Phil. Physics Program, students will

- ❖ be able to enrich their knowledge in the basic and applied areas of Physics like Nuclear Physics, High Energy Physics, Cosmology, Condensed Matter Physics, Rocket Ballistics, Internal Ballistics, External Ballistics and Terminal Ballistics.
- ❖ develop knowledge to handle any kind of advanced scientific instruments used in Physics and Material Science Laboratories.
- ❖ be in a stage to apply their knowledge to identify, analyse problems and to provide effective solution in the area of basic and applied physics.
- ❖ understand the roll of physics in society and develop the background to consider ethical problems.
- ❖ have the knowledge about the recent developments and future possibilities in different branches of physics.

1 st SEMESTER- M. PHIL. –PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-501	Research Methodology & Computer Applications	8	40	60

Objectives	This core course is designed to enable students understand the scientific research methodology.
Pre-Requisites	Basic Computer Knowledge, FORTRAN/C Programming, Numerical analysis
Teaching Scheme	Regular class room lectures with/without use of ICT tools, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus		
Unit	Topics	Hours
I	Research methods – Identification of the Problem – Determining the mode of attack – Literature survey – Mode of approach of actual investigation – Abstraction of a research paper – Drawing inferences from data – Qualitative and Quantitative analysis (Self Study Portion: Qualitative and Quantitative analysis.)	10
II	Writing a thesis or paper – General formation – page and chapter formation. The use of quotation – footnotes – tables and figures – referencing – appendixes – revising the paper or thesis – editing and evaluating and the final product – proof reading – the final types copy. (Self Study Portion: proof reading – the final types copy.)	10
III	Basic architecture of modern computer systems for scientific computing, Basics of programming languages, tools used in scientific computing, MS- Word, MS- EXCEL, Basics of presentation software (MS-Powerpoint); Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts. Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing softwares, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website. Knowledge of Open Source Software, Basics of Python Language (Self Study Portion: Basic architecture of modern computer systems for scientific computing, Basics of programming languages.)	10
IV	FORTRAN Programming: Introduction, I/O Statement, Control Statements, DO Loops, Arrays and Subscripted variables, Sub programs, Data files, C Programming: Constants, variables, data types, Operators and Expressions, I/O Operations, Decision making and Branching, Decision making and Looping, Arrays (Self Study Portion: Decision making and Branching, Decision making and Looping, Arrays)	10
V	Approximations and errors in Computing, Introduction to Numerical Methods, Matrix and linear equations, Roots of nonlinear equations, Numerical Differentiation and Integration, Curve fitting: Interpolation and regression, Numerical solution of Ordinary Differential Equations. (Self Study Portion: Curve fitting: Interpolation and regression.)	10
	Total	50

REFERENCE BOOKS:

1. A Hand Book of Methodology of Research – P. Rajammal and P. Devadoss, R.M.M Vidya Press (1976)
2. Research Methodology- Methods & Techniques, - C.R. Kothari, New Age Publications, New Delhi, 1985
3. Practical Research Methods- Catherine Dawson, UBS Publication, New Delhi, 2002
4. Research Methodology-A step by step Guide for Beginners- Ranjit Kumar, Pearson Education, Singapore
5. Numerical Methods for Physicists, Anthony O’Hare, 2005
6. Numerical Analysis, S. S. Sastry, Prentice Hall of India Pvt. Ltd., New Delhi.
7. Thesis and Assignment Writing – J Anderson, B.H. Burston and M. Poole, Wiley Eastern (1977)..
8. Computer Oriented Numerical Methods – V. Rajaraman, Prentice Hall of India.
9. Numerical Methods for Scientific and Engineering Computation – MK Jain, SRK Iyengar and RK Jain, Wiley Eastern publn.
10. Numerical methods, E. Balagurusamy, Tata McGraw-Hill
11. Elementary Numerical analysis-an algorithmic approach- S.D. Conte and C.de Boor, 1981, 3rd Edition, McGraw Hill.
12. Applied Numerical analysis, B.F. Gerald, and P.O. Wheatley, 1994,5th Edition, Addison-Wesley, M.A.
13. Applied Numerical Methods, B. Carnagan, H.A. Luther and J.O. Wilkes, 1969, Wiley, New York.
14. Numerical Methods, and Computer, S.S. Kuo, 1996, Addison-Wesley.
15. Numerical Recipes in FORTRAN, W.H. Press, 1992, 2nd Edition, Cambridge University press
16. FPRTRAN 77 and Numerical Methods by C. Xavier.

Course Outcome	At the end of this course the learner is expected: <ul style="list-style-type: none">➤ To emphasize the scientific research methodology for thesis writing and review of literatures.➤ To develop numerical problem solving and critical thinking skills.
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1 st SEMESTER- M. PHIL. –PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-502	Advanced Theoretical Physics	8	40	60

Objectives	This core course is designed to enable students understand various methods in material physics and nuclear physics.
Pre-Requisites	Basic Condensed matter physics, nuclear physics, Quantum mechanics
Teaching Scheme	Regular class room lectures with/without use of ICT tools, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus		
Unit	Topics	Hours
	Material Physics	
I	X-ray diffraction Methods: X-ray diffraction and Neutron diffraction basic theory and instrumentation, interpretation of diffraction patterns – indexing, systematic absences – space group determination – use of powder diffraction files – identification of phases – particles size and structure determination of poly-crystalline and amorphous materials. (Self Study Portion: structure determination of poly-crystalline and amorphous materials.)	10
II	Spectroscopic Methods X-Ray Absorption Spectroscopy, Principles, and its applications in Materials science, Introduction to FTIR spectroscopy, basic principle and applications of FTIR spectroscopy & TGA. (Self Study Portion: TGA)	10
III	Microscopic Methods Introduction, basic theory and application of Scanning Electron Microscopy (SEM) and Energy Dispersive x-ray analysis, Transmission Electron Microscopy (TEM), and Atomic Force Microscopy (AFM). (Self Study Portion: Atomic Force Microscopy (AFM).)	10
	Nuclear Reactions	
IV	The Phenomenological Optical Potential Rationale for the optical potential, Partial wave expansion, the radial wave function, Its asymptotic behavior, Elastic scattering amplitude, Coulomb and Nuclear potential, Parameterization of Optical potential, spin-orbit interaction and nucleon elastic scattering, elastic scattering of heavy-ions, the imaginary potential and mean free path, systematic of parameters (Self Study Portion: elastic scattering of heavy-ions, the imaginary potential and mean free path, systematic of parameters)	10
V	Distorted Born Approximation Integral equations and scattering amplitude, the first Bohr Approximation, Distorted-Wave Green's Functions, the Gell-Mann Goldberger Transformation, two potential formula, The DWBA transition amplitude, Antisymmetrization (Self Study Portion: The DWBA transition amplitude, Antisymmetrization.)	10
	Total	50

REFERENCE BOOKS:

1. Crystallography Applied to Applied to Solid State Physics, A.R. Verma & O.N. Srivastava, New Age International Publishers, 2nd Edition, New Delhi
2. Instrumental Methods of Analysis, Willard Merritt, CBS publishers, 2005
3. Electron Microscopy & Microanalysis of Crystalline Materials J A Belk, Appl. Sci. Publishers, 1979.
4. Instrumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean, Frank A. Settle, Jr. CBS Publishers and Distributors, New Delhi
5. Material Science & Engineering: An Introduction by William D. Callister, JWS, Newyork.
6. Solid State Physics, C. Kittel, Wiley- Eastern.
7. The Crystalline State, Vols I and III W.L. Bragg (Ed.), P.T. Bell & Sons London (1952).
8. Crystal Structure Analysis By X-ray Diffraction, H.J. Stout and F. Jensen, Van Nostran (1968).
9. Fundamentals of Crystallography, C. Giacovazzo (Ed.), International Union of Crystallography } .3rd Oxford University Press (1992).
10. Electron Microscopy in the Study of Materials', Arnold M Prutton, 'Surface Physics', 2nd Ed., Clarendon
11. X-ray Diffraction, B.E. Warren, Addison-Wesley Publishing Co. Reading, MA, 1969
12. EXAFS: Basic principles and Data Analysis, B.K. Teo, Springer-Verlag, Berlin, 1986.
13. Introduction to Nuclear Reaction by G. R. Satchler (Macmillan Pub.).
14. Introduction to Nuclear Reaction by C. A. Bertulani, P. Danielewicz (I.O.P. Pub.).
15. The Optical Model of Elastic Scattering by P. E. Hodgson (Oxford Pub.)

Course Outcome	At the end of this course the learner is expected: <ul style="list-style-type: none">➤ To understand the various methods used for characterization of materials.➤ To understand the Optical model used for analysis of nuclear reaction data➤ To use this knowledge in the field of Condensed matter physics, Nuclear Physics and Particle Physics
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1 st SEMESTER- M. PHIL. –PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-503	Research and Publication Ethics (RPE)	2	20	30

Objectives	This core course is designed to aware the students about the publication ethics and publications misconducts.
Pre-Requisites	Basics of research methodology and computer applications
Teaching Scheme	Regular class room lectures with/without use of ICT tools, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus		
Unit	Topics	Hours
	Theory	
I	Philosophy and Ethics:- Introduction to Philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions.	03
II	Scientific Conduct: 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	05
III	Publication Ethics: 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	07
	Practice	
IV	Open Access Publishing: Open Access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self- archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.	04
V	Publication Misconduct: A. Group Discussions: Subject specific ethical issues, FFP, authorship, conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. B. Software Tools: Use of Plagiarism software like Turnitin, Urkund, and other open source software tools.	04
VI	Databases and Research Metrics: A. Database: Indexing databases, citation databases: Web of Science, Scopus, etc B. Research Metrics: Impact factor of Journal as per journal citation Report, SINP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index, almetrics	07
	Total	30
Course Outcome	At the end of this course the learner is expected: ➤ To know about the publication ethics and publication misconducts	

REFERENCE BOOKS:

1. Philosophy of Science, Routledge, A. Bird, 2006
2. A short History of Ethics, London, MacIntyre, Alasdair (1967)
3. Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865.
4. On Being a scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press, National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009)
5. 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>, Resnik, D. B. (2011).
6. Predatory publishers are corrupting open access. Nature, J. Beall (2012) 489 (7415), 179-179, <https://doi.org/10.1038/489179a>
7. Ethics in Science Education, Research and Governance (2019), Indian National Science Academy (INSA), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf



1st SEMESTER- M. PHIL.- PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-504	Advance Practical	6	---	50

Objectives	This practical course enables the students to practice computational techniques along with to handle various instruments covered in their theory papers.
Pre-Requisites	Computer Programming, Material Science, Research Methodology
Teaching Scheme	It is totally based on Laboratory demonstrations and Laboratory realization.

LIST OF EXPERIMENTS	
A. Research Methodology Lab Practice:	
	Programming techniques like FORTRAN, C, C++, Mathematica, Matlab – packages like LaTeX, Word, Power Point, Excel. Application of above for real physics problems. Basic idea about Internet, e-journal, article search
B. Material Science Experiments:	
1	Stress & strain measurement by using UTM.
2	Measurement of Toughness of a material by Impact Testing apparatus.
3	Sample studies by using FTIR/TGA
4	Sample studies by using SEM
C. Nuclear Reaction Computational Programming:	
1	1d, 2d and 3d tunneling problems with different potentials then calculation of reaction cross section for different systems (by using MATLAB or FORTRAN 77 or C or C++ or Python)
2	Nuclear System Analysis by using available code, developing a new code for calculation. (FORTRAN 77 or C or Python)

Course Outcome	At the end of this course the learner is expected: <ul style="list-style-type: none"> ➤ To familiarize the students with Material Science equipments ➤ To impart hands-on experience on Computational Code. ➤ To expert in presentation preparation and thesis writing
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2nd SEMESTER- M. PHIL. PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-601	Review or Proposal Submission for Project	4	---	50
PHY-602	Pre- MPHIL Presentation	4	----	50
PHY-603	Dissertation presentation and Grand Viva	16	----	200

