P.G. DEPARTMENT OF APPLIED PHYSICS AND BALLISTICS

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

FOR THE SESSION2020-21

M.PHIL. PHYSICS

SYLLABUS 2020-2021

P.G. Department of Applied Physics and Ballistics

Approved by BOS on Dt. 13.11.2020

(SFC MODE)

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

M.Phil. in Physics			
First Semester			
Code	Name	Mark	Credit
PHY-501	Scientific Research and Methodology	80+20=100	08
PHY-502	Advance Theoretical Physics	80+20=100	08
PHY-503	Computer Application	20+5=25	02
PHY-504	Advance Practical	75	06
	Total	300	24

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

1st SEMESTER- M. PHIL. -PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-501	Scientific Research and Methodology	8	20	80

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.)**	15
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.)**	15
III	**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)**	15
IV	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.)**	15
	Total	60

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: ➢ To emphasize the scientific research methodology for thesis writing and review of literatures. ➢ To develop numerical problem solving and critical thinking skills.

1st SEMESTER- M. PHIL. -PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-502	Advanced Theoretical Physics	8	20	80

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.)**	15
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 **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: Transmission Electron Microscopy (TEM), and Atomic Force Microscopy (AFM).)**	15
	Nuclear Reactions	
III	**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)**	15
IV	**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.)**	15
	Total	60

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. Instumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean, Frank A. Settle, Jr. CBS Publishers and Distributers, 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 Crystallograph} .3nd 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 rinciples 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: ➢ 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

1st SEMESTER- M. PHIL. -PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-503	Computer Applications	2	05	20

Objectives	This core course is designed to enable students to refresh the knowledge of computer before thesis writing.
Pre-Requisites	Basics of Computers
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	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.)**	15
	Total	15

Course Outcome	At the end of this course the learner is expected: ➢ To refresh the computer knowledge for presentation, paper communication and thesis writing

1st SEMESTER- M. PHIL.- PHYSICS				
Sub. Code	Subject Name	Credit	Int. Marks	Ext. Marks
PHY-504	Advance Practical	6	---	75

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: ➢ To familiarize the students with Material Science equipments ➢ To impart hands-on experience on Computational Code. ➢ To expert in presentation preparation and thesis writing

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	Project and Grand Viva	16	----	200