Syllabus for Pre-Ph.D. course work

PHYSICS

(In accordance with the Guidelines of the NEP-2020)

Effective from the **Academic session 2022-23**

VEER BAHADUR SINGH PURVANCHAL UNIVERSITY

JAUNPUR

Veer Bahadur Singh Purvanchal University, Jaunpur U.P.

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Subject prerequisites: Student/candidate must possess Master degree in Physics

OR

Master degree in any one of the allied subjects as per the list provided by the Board of Studies.

Programme outcomes (POs):

PO1: The course work is intended to give an essence of research work for excellence in different areas in Physics.

PO2: It integrates with specific job opportunities and provides a foundation for (Research) Ph.D Programmes.

PO3: The course work will enrich the students able to understand that acquiring knowledge and skills appropriate to their professional activities is a never-ending process.

PO4: This course work will promote an interest in research and implement various techniques to find new theories and theorem in recent research programme among students.

PO5: The present course work will offer students to handle equipments for material preparation, characterization and to analyze/ interpret the data with theoretical background/software.

PO6: The motive of the following course work is to train the students to demonstrate a thorough understanding of research methodologies and techniques at an advanced level.

PO7: Inspire them in such a way that they can demonstrate and maintain the highest standard on ethical issues in their professional lives.

PO8: It will help to develop and enhance their communicative skills and teaching abilities

PO9: It will transform the overall persona of students by inculcating ethical values and scientific temperament and helps them to be persons of integrity, to be responsible and enlightened citizens with a commitment to deliver good to the society within the scope of the bestowed rights and privileges.

Programme specific outcomes (PSOs): The present course work offers to

PSO1: Develop specialization in a particular area of physics research.

PSO2: Train the students over a wide range of analytical and/or experimental and/or computational techniques that can be applied in physics, in other scientific and technological domains.

PSO3: Acquire knowledge regarding the overall scientific progress (chronological) so that the results of a particular problem can be placed with proper perspective.

PSO4: Pursue Ph.D programme with norms of scholarly research that chip in to the augmentation of student's personal and professional development.

PSO5: Design and conduct experiments as well as interpret data. Communicate effectively the research findings to the scientific community.

PSO6: Equip themselves to good communication skills and teaching abilities.

PSO7: Evolve as excellent professionals and contribute towards the scientific growth of the country.

List of papers for Pre-Ph.D. course work or Post graduate diploma in Research (PGDR)

Year	Sem	Course Code	Course Title	Theory/ Research	Credit	Max. Marks
6	XI	B011101T	Experimental and Theoretical Methods / Techniques based course	Theory	6	100 [25(CIE)+75(UE)]
		B011102T	Advanced Physics	Theory	6	100 [25(CIE)+75(UE)]
		B011103T	Research Methodology, Research Publication Ethics and Computer Applications	Theory	4	100 [25(CIE)+75(UE)]
		B011104R	Research Project	Research	-	100 [25(CIE)+75(UE)]

Credit system:

- A four (4) credit theory course/paper will have four Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 60 Lectures.
- Similarly, a six (6) credit theory course/paper will have six Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 90 Lectures.

Continuous Internal Evaluation (CIE) of 25 marks:

- Continuous internal evaluation will be performed by the teacher/ course coordinator concerned.
- CIE shall be 25% of total assessment in a Theory paper and research project.
- 25 marks shall be distributed as 5 marks for attendance, 5 marks for presentation and assignment and remaining 15 marks for class test.

Marking system:

- All papers will have a total maximum mark of 100, including both CIE and University Examination (UE). Maximum marks of 25 will be allotted to CIE and 75 to UE in a theory paper/ research project.
- The CIE of the research project shall be evaluated by the research supervisor and co-supervisor (if any).
- 75 marks of **research project** shall be distributed as 50 marks (project work and presentation) and a viva voce of 25 marks.
- The evaluation (Max Marks 75 UE) of the research project shall be done by internal examiner/s (Supervisor and Co-supervisor (if any)) and one external examiner appointed by the University.

Research Project Submission:

- The evaluated research project report in two sets of hard copy (spiral binding) must be prepared. One copy of it shall be submitted to the university if it demands. A second copy of the evaluated research project report must be in the records of the college/research centre.
- The format of university Ph.D. thesis writing guidelines can be used as format of Research project writing guidelines.

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject: PHYSICS		
Course Code: B011101T	**Course Title:** Experimental and Theoretical Methods / Techniques based course	

Course Outcomes (COs) : With the completion of the present course, the students will be able to:

CO1: Measure the various crystal parameters using XRD, XPS, SEM, TEM etc.

CO2: Analyze and utilize various spectroscopic techniques like, infrared, ultraviolet, visible, Raman etc.

CO3: Discuss Lagrangian and Hamiltonian methods, Hamilton-Jacoby theory, Schrodinger wave equation etc. to solve classical and quantum mechanical problems.

CO4: Explain Maxwell's equation, pointing vector and physics behind reflection, refraction (electromagnetic waves) and waveguides.

CO5: Outline the basic concepts in thermodynamics, quantum statistics, phase transition etc.

CO6: Determine the solution of algebraic and transcendental differential equations through various numerical methods.

CO7: Outline the concept of data fitting and chi-square test. Knowledge of the plotting package- origin.

Credits: 6	Core Compulsory
Max. Marks: 25(CIE) + 75(UE)	Min. Passing marks: 55

Total number of lectures: Lectures-Tutorial-Practical (6 hours in a week) L-T-P: 6-0-0 **(90 hr)**

Unit	Topics	No. of Lecture Hrs.
I.	Basic principles of elastic scattering of X-ray, electron and neutron diffraction, X-ray photoelectron spectroscopy (XPS), atomic resolution electron microscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM).	15
II.	Basic principle and simple application of Infrared and ultraviolet/visible (IR, UV/Vi) spectroscopy, Mossbauer spectroscopy, Raman and Fluorescence spectroscopy.	15
III.	Lagrangian and Hamiltonian methods, Hamilton-Jacoby theory, relativistic kinematics, Schrodinger wave equation, operator methods, quantum mechanics for a system of particles, Dirac equation.	15
IV.	Maxwell's equations, Poynting vector, electromagnetic waves, reflection, refraction, waveguides and radiating systems.	15
V.	Basic concepts in thermodynamics, quantum statistics, systematic of phase transitions, Ginsburg Landau theory.	15
VI.	Numerical integration, solving differential equations, Runge-Kutta and Simpsons methods, data fitting, chi-squares, goodness of fit, basic Fortran/ Matlab/ Python and plotting packages-Origin.	15

Suggested Readings:

1. Culity B. D., "Elements of x-ray diffraction", Prentice Hall, 2001.
2. Barrow G.M., "Introduction to Molecular Spectroscopy", McGraw-Hill, 1962.
3. Fausett, "Applied Numerical Analysis Using MATLAB", Pearson Education, 2009.
4. Goldstein H., Poole C. P., Safko J. L. "Classical Mechanics", Addision Wesley, 2001.
5. Griffiths D. J., "Introduction to Electrodynamics", Springer, 2001.
6. Patharia R. K., "Statistical mechanics", Elsevier Science, 2016.

Suggestive digital platforms / web links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject: PHYSICS		
Course Code: B011102T	Course Title: Advanced Physics	

Course Outcomes (COs) : With the completion of the present course, the students will be able to:

CO1: Explain magnetism and magnetic materials, x-ray diffraction, Laue, rotating crystal and powder method.

CO2: Discuss atomic and molecular spectra, FT, FT-IR, FT-Raman spectroscopy and its advantages and applications.

CO3: Recall the nuclear structure, nuclear stability, nuclear fission and fusion, nuclear energy and nuclear reactor, nuclear accelerator and Large Hadron Collider (LHC).

CO4: Explain optical excitations in semiconductors, photoconductive devices, LED, solar cell and photo detectors.

CO5: Elaborate the structure of sun, solar activity, ozone, ozone hole and its impact on climate.

Credits: 6	Core Compulsory
Max. Marks: 25(CIE) + 75(UE)	Min. Passing marks: 55

Total number of lectures: Lectures-Tutorial-Practical (6 hours in a week) L-T-P: 6-0-0 **(90 hr)**

Unit	Topics	No. of Lecture Hrs.
I	Elementary idea of x-ray diffraction, Laue method, Bragg's law, rotating crystal and powder methods. Magnetism: magnetization, magnetic permeability, magnetic susceptibility, different types of magnetic materials, molecular field theory, B-H curve.	18
II	Atomic and molecular states, electronic, vibrational, rotational spectra, concept of allowed and forbidden transitions. Principles of Fourier transform (FT) spectroscopy, FT-IR and FT-Raman spectrometer, advantages of FT technique over the conventional method, application of IR and Raman spectroscopy.	18
III	Parameterization of nuclear masses (Weizsaecker formula), properties of nuclear matter, nuclear stability, nuclear fission and fusion processes, production of nuclear energy and working of a reactor, shell model of nuclei. Classification of accelerators, principle and design of ion sources, linear accelerators, Large Hadron Collider (LHC).	18
IV	Optical Excitation in Semiconductor: Optical absorption, carrier generation, Carrier life time, diffusion length and photo conductivity, Direct and indirect recombination and trapping, Photoconductive devices. LED: Radiative transition, Emission spectra, Luminous efficiency and LED materials, Solar cell and photodetectors: Ideal conversion efficiency, Fill factor, Spectral response. Reverse saturation current in photodetector.	18

V	Solar Structure, Solar Atmosphere, Sun Magnetic field. Development of Centre of Activity: Sunspot, Prominences, flares and Coronal mass ejections, Solar wind and solar wind observations, Interaction of solar wind with magnetosphere, Geomagnetic Storms. Temporal & spatial variation of ozone, Ozone hole and its impact on climate and Aerosols.	18

Suggested Readings:

1. Culity B. D., "Elements of x-ray diffraction", Prentice Hall, 2001.
2. Culity B. D., Graham C. D., "Introduction to Magnetic Materials" Wiley-IEEE Press, 2008.
3. Barrow G.M., "Introduction to Molecular Spectroscopy", McGraw-Hill, 1962.
4. Roy R.R. and Nigam B.P., "Nuclear Physics (Theory and Experiment)" Wiley Eastern Ltd., New Delhi, 1993.
5. Streetman B.G., Banerjee S.K., "Solid State Electronic Devices", Pearson Education India, 2015.
6. Singhal R. P., "Elements of Space Physics", Prentice Hall of India, New Delhi, 2020.
7. Philips Kenneth J. H., "Guide to the Sun", Cambridge University Press, 1995

Suggestive digital platforms / web links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel,

   https://www.swayamprabha.gov.in/index.php/program/current_he/8

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI

Subject: PHYSICS

Course Code: B011103T	Course Title: Research Methodology, Research Publication Ethics and Computer Applications

Course Outcomes (COs): With the completion of the present course, the students will be able to-

CO1: With the help of this course, students will be able to decide the research field, topic, design, and pros and cons of research, sampling, and data collection techniques.

CO2: The student will be able to understand the research process and acquire the skill of writing research articles.

CO3: The course will enable you to execute the best practices, morals, and ethical values in scientific conduct and avoid publication misconduct.

CO4: With the help of this course, students will be able to learn about the standards of journals for good-quality publications of their research work.

CO5: After this course, the students will be able to learn how to use computers and different application software for manuscript writing.

CO6: This course will enable the students to learn about reference management and the maintenance of academic integrity using scientific tools. They will be familiar with the protection of the machines from computer hazards.

Credits: 4	Core Compulsory
Max. Marks: 25(CIE) + 75(UE)	Min. Passing marks: 55

Total number of lectures: Lectures-Tutorial-Practical (4 hours in a week) L-T-P: 4-0-0 **(60 hr)**

Unit	Topics	No. of Lecture Hrs.
I	**Research Methodology** Definition, and Objectives, Motivation and Significance of Research, Types of Research, Truth and Facts of Research, Similarity and Contrast in Literary Research and Scientific Research, Research and Criticism, Research Problem and Research Design, Sampling Design and Methods of Data Collection.	12
II	**Research standards:** Layout of the Research Report, Research Process: subject Selection, Outline of the Research, Review of Literature, Material Collection; Testing and Classification, Analysis, Discussion and Conclusions, Precautions in Writing Synopsis/Research Paper/Thesis/Research Report.	12
III	**Philosophy, Ethics, Scientific Conducts and misconducts** Moral Philosophy, Nature of Moral Judgments and Reactions, Publication Ethics, Best Practices/Standards Setting Initiatives and Guidelines: Committee on Publication Ethics (COPE), World Association of Medical Editors (WAME) etc., Intellectual Honesty and Research Integrity: Falsification, Fabrication and Plagiarism (FFP), Open Access Publishing, and Publication Misconduct.	08
IV	**Databases and Research Metrics**	08

	Databases: Indexing Databases, Citation Databases: Web of Science, Scopus etc., Research Metrics: Impact Factor of Journal as Per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-Index, g-Index, i-10 Index, and Altimetric.	
V	**Fundamentals of Computers and application Softwares** Types Of Computers, Computer Peripherals and internal component, Types of Operating Systems, Web Browser, Web Search Engine, Spreadsheet Processing, Presentation (MS PowerPoints Preparation or Beamer or Libre Office (Optional), Project/Thesis/Report writing, Using MS-Word or LaTeX or LibreOffice documentation style Labelling, References Style, Footnotes etc.	**12**
VI	**Scientific Softwares** Use of Reference Management Software Like Mendeley, Zotero, Reference Manager, Endnote, Authorea Etc. Anti-Plagiarism Software Like Turnitin, iAuthenticate, Urkund, Ebooks and Virtual Library, UGC-Infonet, Computer Hazards and Security	**08**

Suggested Readings:

1. C.R. Kothari, *Research methodology Methods and Techniques*, 4th Edition, New Age International (P) Ltd. Publisher, 2014.
2. W. Creswell, *Research Design, Qualitative, Quantitative and mixed method approaches*, 3rd Edition, Sage Publications, Inc.
3. D.B. Resnik, (2011) What is ethics in research & Why is it important. National institute of Environmental Health Science, 1-10 Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
4. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1-7. https://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. Reema Thareja (2019) Fundamentals Of Computers (2nd Edition), Oxford University Press
6. Microsoft Office 365 : A complete Guide to Master Word, Excel, and PowerPoint 365 for Beginners, Matt Vic
7. Leslie Lamport, LaTeX, A Document Preparation System, 2nd Edition, Addison-Wesley Professional Publisher, July, 1994.
8. Latex tutorials https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
9. Libre Office tutorial: www.documentation.libreoffice.org/en/english-documentation

Suggested equivalent online courses: https://epgp.inflibnet.ac.in/

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject: PHYSICS		
Course Code: B011104R	**Course Title: Research Project**	
Course Outcomes (COs): With the completion of the present course, the students will be able to: CO1: Implement effective academic and personal strategies for carrying out research projects independently and ethically. CO2: Acquire an overall knowledge of the ongoing scientific research within/ outside the country. CO3: Develop reasonably good communication skills - ability to present scientific results and thoughts to the educated audience. CO4: Analyze problems starting from first principles, evaluate and validate experimental results, and draw logical conclusions thereof.		
Credits: Non -Credit	**Core Compulsory**	
Max. Marks: 25(CIE) + 75(UE)	**Min. Passing marks: 55**	

Suggested Readings:

1. Halyna M. Kornuta, Ron W. Germaine, "A Concise Guide to Writing a Thesis Or Dissertation -Educational Research and Beyond" Routledge, Taylor & Francis Group, 2019.
2. Derek Swetnam, Ruth Swetnam, "Writing Your Dissertation- The Bestselling Guide to Planning, Preparing and Presenting First-Class Work."
3. Marialuisa Aliotta, "Mastering Academic Writing in the Sciences, A Step-by-Step Guide" CRC Press, 2018.