D E P A R T M E N T O F P H Y S I C S

Ph.D. PROGRAMME in PHYSICS

(One semester Course work)
(Courses effective from Academic Session 2016-2017)

SYLLABI OF COURSES TO BE OFFERED

(As per Ordinance 23 (A), and UGC Guidelines -2016)

SCHOOL OF MATHEMATICAL AND PHYSICAL SCIENCES
DOCTOR HARISINGH GOUR VISHWAVIDYALAYA
SAGAR (M.P.) 470003

Course work for Ph.D. in Physics

Session 2016-17

Course Structure

I Semester

Core Courses:

		L	T	P	C
PHY CC 141	Research Methodology	3	1	0	4
PHY CC 142	Advances in Physics	3	1	0	4
PHY CC 143	Review of Literature (Dissertation)	Self Study			4

Elective Course (any one of the following)

PHY EC 141	Advanced Theoretical Methods	3	1	0	4
PHY EC 142	Advanced Experimental Methods	3	0	1	4
PHY EC 143	Advanced Electronic Systems	3	0	1	4

Core credits	=	8
Elective Credits	=	4
Review of Literature (Dissertation)	=	4
Total Credits	=	**16**

The detailed syllabi of each course follow on pages 3 to 9.

Ph.D. (Physics): I Semester
Session: 2016-17

PHY CC 141	**Research Methodology**	3	1	0	4

Mode of study includes assigning the topic to students based on their basic background and presentation in the form of seminar which will be followed by discussion and submission of the write-up. There may not be any formal classroom teaching.

Unit I
Principles of Scientific Research:
Definition – History – Evolution of Scientific Inquiry
Meaning and importance of research – Types of Research, Research Design – Need – Features – Inductive, Deductive and Development models
Analysis of Literature Review – Primary and Secondary Sources, Web sources –critical Literature Review
Hypothesis – Different Types – Significance – Development of Working Hypothesis
Research Methods: Scientific method vs. Arbitrary Method, Logical Scientific Methods
(Lectures – 9)

Unit II
Data Collection and Analysis:
Sources of data: Primary, Secondary and Tertiary.
Methods of collecting data: Observation, field investigations, direct studies – Reports, Records of Experimental observations.
Sampling methods: Data Processing and Analysis strategies, Graphical representation – Descriptive Analysis – Inferential Analysis- Correlation analysis – Least square method - Data Analysis using statistical package – Hypothesis – testing – Generalization and Interpretation – Modeling. **(Lectures – 9)**

Unit III
Scientific Writing:
Structure and components of Scientific Reports, types of report: Technical Reports and Thesis.
Different steps in the preparation: Layout, structure and language of typical reports, illustrations and tables; Bibliography, referencing and foot notes.
Oral presentation: Planning, preparation and practice, making presentation; use of visual aids; importance of effective communication.
Preparing Research papers for journals, seminars and conferences; design of paper using TEMPLATE; Impact factor of a journal, citation index, ISBN & ISSN.
Preparation of Project Proposal: Title, Abstract, Introduction – Rationale, Objectives, Methodology; Time frame and work plan; Budget and Justification
(Lectures – 9)

Unit IV
IPR and Ethical Issues:
Intellectual Property rights and patent law; copy right – royalty related aspects of intellectual property rights, commercialization; Ethical Issues, Ethical Committees. Reproduction of published material: plagiarism, citation and acknowledgement; reproducibility and accountability.

Unit V

Application of Computer in Research:

MS office and its application in Research: MS Word, MS Power point and MS Excel; statistical computation using SPSS.

Use of Internet in Research – Websites, searches engines, E-journal and E-Library, INFLIBNET.

(Lectures – 9)

Essential Readings:

1. An introduction to Research Methodology,. Garg.B.L. Karadia, R., Agarwal,F. and Agarwal, RBSA Publishers U.K., 2002
2. Research Methodology: Methods and Techniques. Kothari, C.R.Second Edition. New Age International Publishers, New Delhi.2008
3. Research Methodology, Sinha, S.C. and Dhiman, A.K.Ess Ess Publications, 2002
4. How to write and publish a scientific paper. Day, R.A. Cambridge University Press. London, 1992
5. Philosophy of Natural science Englewood Cliffs, Hempel,C. N.J: Prentice Hall, 1966.
6. The Metaphysical Foundations of Modern Science. Burtt, E.A, .London, 2003.
7. Laboratory Life. The construction of scientific facts. Latour, B. & Woolgar. 3, 2nd Edition. Princeton: Princeton University Press.1986
8. Statistical Methods. 37th ed. (Rev) Gupta S.P., Sultan Chand and Sons. New Delhi,2008
9. Indian Philosophy and Philosophy of Science, Sundar Sarukkai Motilal Banarsidass Publishers Pvt.Ltd. New Delhi. 2008

Suggested Readings:

10. Introductory probability and Statistics; Applications for forestry and Natural sciences.CAB International,Kozak A, Kozak R.A., Staudhammer C.L., and Watts S.B., UK.408p,2008
11. Internet for Everyone, Vikas Publishing House. Leon & Leon (2202).
12. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing. Wadehra, B.L., 2000.
13. Metropolitan Book Comp. Ltd. *Chandera A. and Sexena T.P.)* Style Manual, New Delhi, *2000*
14. Computer Fundamentals, Sinha P.K. BPB Publications, New Delhi. 1992.
15. Advanced Engineering Mathematics – Erwin Kreyszig, Wiley International 9th Ed.

Ph.D. (Physics): I Semester
Session: 2016-17

PHY CC 142	**Advances in Physics**	3	1	0	4

UNIT I

History of Science: Emergence of science, dark ages, beginning of modern science, the renaissance: the "Golden Age" of science, the era of Newton, industrial revolution, the remaining part of 19th century, modern science.

The Origin of the Universe: theories of the origin of the universe by ancient Greeks, the birth and growth of the universe, the Big Bang theory, Quantum Cosmological Theory, Milky Way and external galaxies, galaxies and their classification, the solar system and planet earth.

UNIT II

Brief History of Physics: Definition and origin of physics, stages in the history of physics: antiquity, middle ages, renaissance, modern age.

Early atomic and molecular theories, the breakdown of classical physics, quantization of electromagnetic radiation, the era of modern physics; structure of atom, the nucleus, elementary particles; the truth about space and time: Einstein's special theory of relativity, space and time in Einstein's general relativity.

UNIT III

Fundamental Forces: The Four Fundamental Forces, Strong Force, the Electromagnetic Force, the Weak Force, Gravity; Unification of forces: the grand unification theory.

Elementary Particles: The Elementary Particles, matter and antimatter, pair production and annihilation, antimatter in the universe; the Standard Model, the Higgs particle, the Large Hadron Collider.

UNIT IV

Black Holes: History, discovery of black holes, formation and characteristics of black holes, birth of a black hole**,** evidence of black holes**,** behavior of light with respect to gravity, white dwarf, neutron stars.

Dark Matter: Hidden Mass in the universe, theories of dark matter, massive astrophysical compact halo objects (MACHOs), dark matter and the big bang theory, fate of the universe, theory of dark energy; Cosmic hide and seek: the search for the missing mass, determining the mass of galaxies.

UNIT V

Technology and Society: Impact of science and technology, differences between science and technology, impact of science and technology on various aspects of people's lives, concept of intermediate or appropriate technology, challenges of science and technology.

Man and his Energy Resources: Energy resources, energy generation and the environment, energy in the atmosphere: wind and solar energy.

Essential Readings:

1. The Evolution of Physics- Einstein and L. Infeld, Toughstone 1967.
2. The Ascent of Man- J. Bronowski, Liffle and Brown Company, 1976.
3. Cosmos- Carl Sagan, McDonald and Company, 2003.
4. In search of Schrodinger's Cat- John Gribbin, Random House, 2012

Suggested Readings:

5. Chaos- James Gleick, Viking Penguin, 1987
6. Doubt And Certainty – Tony Rothman and George Sudarshan (Helix books, Cambridge,1998
7. Toa of Physics – Fritjof Capra, Shambhala Publication 3rd Edition. 1975.

Ph.D. Physics: I Semester
SESSION: 2016-17

		L	T	P	C
PHY EC 141	**Advanced Plasma Physics**	3	1	0	4

UNIT - I
Characteristic Properties of Plasma:

The occurrence and importance of plasma in nature, Plasma approximation, Concept of Debye length, Plasma parameter, Plasma frequency, Classification of plasma, Some basic plasma phenomena, Controlled thermonuclear fusion. **(Lectures -12)**

UNIT - II
Dynamics of charged particles:

General law for motion of charged particles in electric field, Motion in an alternating electric field, Particle motion in presence of magnetic field, Time varying magnetic field and space varying electric field equation of motion, Curvature and gradient drift, Adiabatic invariance of magnetic moment. Pondermotive force. **(Lectures -12)**

UNIT - III
Introduction to Kinetic Theory:

The meaning of f (v), Equation of Kinetic Theory, Derivation of the Fluid Equations, Plasma Oscillation and Landau Damping, A Physical derivation of Landau Damping, BGK and Van Kampen Modes, Experimental verification, Ion Landau Damping. **(Lectures -12)**

UNIT - IV
Waves in Plasma:

Electromagnetic waves in free space (wave equation, solution in plane wave, harmonic waves, energy flow, wave packet and group velocity), Magneto hydrodynamic waves (Alfven waves, Magneto-sonic waves), Waves in cold plasma (basic equation of magneto-sonic theory, plane wave solution and linearization), Waves in warm plasma (waves in a fully ionized isotropic warm plasma, derivation of the equations for the electron and ion velocities, longitudinal waves, transverse waves).

(Lectures -12)

Essential Readings:

1. Fundamental of Plasma Physics by J.A. Bittencourt (IIIrd edition), Springer., 2004
2. Introduction to Unmagnetized Plasma by C. Uberoi, Prentice Hall of India. 1990

Suggested Readings:

3. Introduction to Plasma Physics by F.F. Chen, Springer.1974

Ph.D. Physics: I Semester
SESSION: 2016-17

PHY EC 142	**Advanced Experimental Methods**	3	0	1	4

Unit – I

Synthesis Techniques: Crystal Growth and Wafer Preparation, Thin Film Evaporation Process, Physics of Sputtering and Ion beam processing of thin films, Chemical Vapor Deposition, Substrate surface and thin film Nucleation, Epitaxy, Oxidation, Lithography, Ion implantation, Etching and Cleaning. **(Lectures – 12)**

Unit –II

Structure and Microstructure: Structural and Micro-structural Techniques: X-ray diffraction, Energy Dispersive X-ray analysis, SEM, TEM, AFM, STM. Magnetic Force Microscopy (MFM), Ellipsometry, Spectroscopic techniques: Spectrophotometry, FTIR spectroscopy, Raman spectroscopy, Photoluminescence, Nuclear Magnetic Resonance (NMR) spectroscopy.

(Lectures – 12)

Unit –III

Physical Properties: Physical Properties Measurement Techniques: Electrical Characterizations: Measurement of resistivity by four-probe method, Dielectric, Impedance and Ferroelectric hysteresis measurements. Vibrating Sample Magnetometer (VSM), Superconducting Quantum Interference Device (SQUID). Heat capacity measurements, Thermal characterization techniques: Differential Scanning Calorimeter (DSC), Thermo-Gravimetric and Differential Thermal Analyzer (TG-DTA).

(Lectures – 12)

Unit - IV

Spectroscopic Characterization : Double Beam IR Spectrometers, Basic Concepts of Raman Spectroscopy in Solids, Sensitive Detectors such as PMT CCD Camera, characterization of solid thin films through ellipsometry, Identification and Analysis of Optic and Acoustic, Modes in Solids, Electronics Absorption Study for Band Gap Determination.

(Lectures – 12)

Essential Readings:

1. W. Demtroder, *Laser Spectroscopy Basic Concepts and Instruments, third edition,* Springer 2004.
2. X-ray Diffraction, B. D. Cullity, Addison-Wesley Publishing Company, Inc., 2013
3. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AFM by Ray F. Egerton, Springer. 2005
4. Transmission Electron Microscopy, D. B. Williams and C. B. Carter, Springer.,2009
5. Principles of Fluorescence Spectroscopy by Lakowicz publisher Kulwer Academic/Plenum.,1999

Suggested Readings:

6. Thermal Characterization of Polymeric materials by E. Turi, Elsevier 1981.
7. Broadband Dielectric Spectroscopy by Kremer, Friedrich, Schonhals & Andreas, Springer 2003.
8. Physical Properties of Crystals by J.F. Nye, Oxford University Press., 1985
9. Dielectric Relaxation in Solids by A.K. Johnscher, Chelsea Dielectric press, 2006
10. Physical principles Electron Microscopy by – R.F. Egerton, Springer 2005
11. Instrumental Methods of Analysis Willard, H.H., Merit L.L., Dean J.A Seattl e F.L., CBS publishing and Distribution, 1995

Ph.D. (Physics): I Semester
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		L	T	P	C
PHY EC 143	**Advanced Electronic Systems**	3	0	1	4

UNIT - I

Microprocessor Architecture:

Instruction Set, Data Format, Instruction Format, Addressing mode. Memory Hierarchy: Register file, Cache, Virtual memory and paging, Segmentation.

Pipeline: The instruction Pipeline, Pipeline Hazards, Instruction level parallelism.

Reduce Instruction set computer principles: RISC versus CISC, RISC properties, RISC evaluation, on chip register file versus cache evaluation. **(Lectures – 12)**

UNIT - II

Advanced RISC microprocessor: The Alpha AXP architecture, Alpha AXP implementation, the power PC architecture, the power PC601, The IBM PS 6000, SPARC architecture; the earlier SPARC implementation, MIPS architecture, MIPS R4000 & R4400, their implementation, Intel i860 family.

Introduction to Embedded system: Processor in the system, other hardware units, software embedded into system. **(Lectures – 12)**

UNIT - III

Processor & Memory Organization: Processor selection, memory devices, memory selection, DMA, Interfacing processor memory and IO devices.

Design Technology: Automation-Synthesis, Verification – Hardware/Software co-simulation, Simulation Speed, Emulators, Reuses, Design process Models. **(Lectures – 12)**

UNIT - IV

Devices, Buses, Drivers and Interrupt mechanism: IO devices, Timer and counting devices, serial communication [I^2C, CAN], Advanced IO buses between Networked multiple devices, Host computer and Parallel communication between the Networked IO devices using ISA, PCI, PCI-X and Advanced Buses, Device Derives, Interrupt mechanism, Programming concept.

(Lectures – 12)

Essential Readings:

1. Advanced Microprocessor – Daniel Tabak, McGraw Hill., 1991
2. Embedded Systems (Archtecture, Programming & Design) - Raj Kamal, Tata Mcgraw Hill.2003

Suggested Readings:

3. Embedded system Design (A unfied Harware/Software Introduction) – Frank Vahid & Tony Givargis, Willey India.2002

Ph.D. (Physics): I Semester
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		L T P	C
PHY CC 143	**Review of Literature (dissertation)**	**Self Study**	**4**

Each Research Scholar will be assigned a (departmental) faculty member as Supervisor on the topic of his/her interest.

The students are required to submit a dissertation on the topic/area of research assigned to him/her under the Supervisor allocated to him/her advisor the Department.

The evaluation of the dissertation and viva on it shall be on the lines as mentioned in the ordinance for the purpose.

PHY CC 141	Research Methodology	3	1	0	4
PHY CC 142	Advances in Physics	3	1	0	4
PHY CC 143	Review of Literature (Dissertation)	Self Study			4
PHY EC 141	Advanced Theoretical Methods	3	1	0	4
PHY EC 142	Advanced Experimental Methods	3	0	1	4
PHY EC 143	Advanced Electronic Systems	3	0	1	4

Elective Course (any one of the following)