

No - PHY/2021/283

30/07/2021

(Annexure-I)

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR M.P.
(A CENTRAL UNIVERSITY)
DEPARTMENT OF PHYSICS

DEPARTMENT OF PHYSICS

Ph.D. PROGRAMME in PHYSICS

(One semester Course work)
(Courses effective from Academic Session 2020-2021)



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
(A CENTRAL UNIVERSITY)

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D. Shukla
29/7/21

Dr. P.K. Khare
29/6/21

Dr. P.K. Khare
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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR M.P.
(A CENTRAL UNIVERSITY)
DEPARTMENT OF PHYSICS

Course work for Ph.D. in Physics

Session 2020-21

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
PHY CC 144	Research and Publication Ethics (RPE)	2	-	-	2

Elective Course (any one of the following)

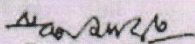
PHY EC 141	Advanced Theoretical Methods	3	1	0	4
PHY EC 142	Advanced Experimental Methods	3	0	1	4
PHY EC 143	Advanced Electronic Systems	3	0	1	4

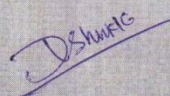
Core credits = 10

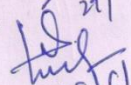
Elective Credits = 4

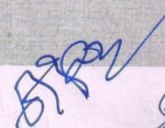
Review of Literature (Dissertation) = 4

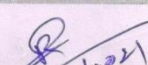
Total Credits = 18


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Ph.D. (Physics): I Semester

Session: 2020-2021

Core Course

PHY CC 141	Research Methodology	3	1	0	4
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Objective:- This paper is designed to teach research scholars about meaning and importance of research. Research methodology also give information about basic research needs like problem detection and hypothesis and is solution by data collection and analysis.

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 –12)

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 –12)

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 –12)

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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.
(Lectures –12)

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 –12)

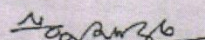
Expected Outcomes:- research scholars will know about research and how to define research problem. They also learn about various parts of research paper and scientific writing.

Essential Readings:

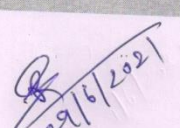
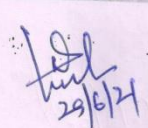
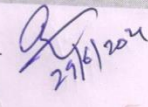
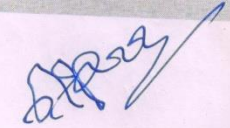
1. An introduction to Research Methodology.. Garg.B.L. Karadia, R., Agarwal,F. and Agarwal, RBSA Publishers U.K., 2002
2. Research Methodology: Methods and Techniques. Kothari, C.R. Second Edition. New Age International Publishers, New Delhi. 2008
3. Research Methodology, Sinha, S.C. and Dhiman, A.K. 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. Burt, 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. Chandra 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.


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Ph.D. (Physics): I Semester
Session: 2020-2021
Core Course

PHY CC 142	Advances in Physics	3	1	0	4
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Objective:- The main objective of this paper is to give information to scholars about physics theories behind origin of the universe, black holes, dark matter etc.

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. (Lectures -12)

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. (Lectures - 12)

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. (Lectures - 12)

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. (Lectures - 12)

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. (Lectures - 12)

Outcomes:- Research scholars will know physics behind various phenomena universe and learn physics theories about these phenomena. Student also get familiar with elementary particles and fundamental forces.

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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.

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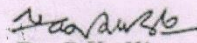
Ph.D. (Physics): I Semester
SESSION: 2020-2021
Core Course

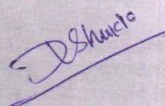
PHY CC 143	Review of Literature (dissertation)	L	T	P	C
		Self Study			4

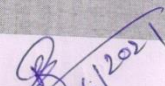
Each Research Scholar will be assigned a (departmental) faculty member as Supervisor on the topic of his/her interest.

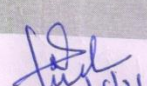
The students are required to submit a dissertation on the topic/area of research assigned to him/her under the Supervisor allocated to him/her advisor the Department.

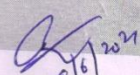
The evaluation of the dissertation and viva on it shall be on the lines as mentioned in the ordinance for the purpose.

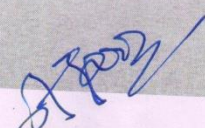

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DEPARTMENT OF PHYSICS

Ph.D. (Physics): I Semester
Session: 2020-2021
Core Course

		L	T	P	C
PHY CC 144	Research and Publication Ethics (RPE)	2	-	-	2

Theory: Lectures

Credits: 02

Objective :

This course has total 5 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

UNIT – I : THEORY

PHILOSOPHY AND ETHICS (3hrs)

1. Introduction to philosophy: definition, nature and scope, concept, branches.
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

SCIENTIFIC CONDUCT (5hrs)

1. Ethics with respect to science and research.
2. Intellectual honesty and research integrity.
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publication, salami slicing.
5. Selective reporting and misrepresentation of data.

UNIT – II : PUBLICATION ETHICS (7hrs)

1. Publication ethics: definition, introduction and importance.
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest.
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types.
5. Violation of publication ethics, authorship and contributorship.
6. Identification of publication misconduct, complaints and appeals.
7. Predatory publishers and journals.

UNIT – III : OPEN ACCESS PUBLISHING (4hrs)

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/journal suggestion tools viz, JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

UNIT – IV : PUBLICATION MISCONDUCT (4hrs)

Group Discussions (2hrs)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

Software tools (2hrs)

Use of plagiarism software like Turnitin, Urkund and other open source software tools.

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UNIT - V : DATABASES AND RESEARCH METRICS (7hrs)

Databases (4hrs)

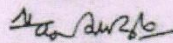
1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

Research Metrics (3hrs)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score.
2. Metrics: h-index, g index, i10 index, altmetrics

References :

1. Bird, A. (2006), Philosophy of Science, Routledge.
2. MacIntyre, Alasdair (1967) A Short History of Ethics, London.
3. P. Chaddsh, (2018)) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. 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, National Academics Press.
5. Resnik, B.D. (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/resources/bioethics/whatis/index.cfm>
6. Beall, J. (2012), Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
6. 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 Books pdf>


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DEPARTMENT OF PHYSICS

Ph.D. Physics: I Semester
SESSION: 2020-2021
Elective Course

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

Objective:- The advanced concepts and included in the syllabus according to present needs and deeds in laboratory and space plasma research. This syllabus provides the background for space plasmas, astrophysical plasmas and cosmology. This paper will also enhance the concepts related to earth and atmospheric physics.

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.

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, Ponderomotive force.

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.

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).

UNIT - V

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).

Outcomes: The research scholar will be able to develop and use the appropriate concepts for applications in various branches of plasma physics.

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

Suggested e-books :

Introduction to Plasma theory by D.R. Nicholson, Wiley Publication.
Fundamentals of Plasma Physics by P.M. Bellan.

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Ph.D. Physics: I Semester

SESSION: 2020-2021

Elective Course

PHY EC 142	Advanced Experimental Methods	3	0	1	4
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Objective: the course of advanced Experimental methods designed to teach students about preparation of nano- materials, fabrication of this titan by various techniques .it also provide knowledge about characterization techniques'.

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.

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.

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),

Unit - IV

Superconducting Quantum Interference Device (SQUID). Heat capacity measurements, Thermal characterization techniques: Differential Scanning Calorimeter (DSC), ThermoGravimetric and Differential Thermal Analyzer (TG-DTA).

Unit - V

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.

Outcomes:- the research scholar will know about the multiple characterization techniques .

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, Schönhalz & Andreas, Springer 2003.
8. *Physical Properties of Crystals* by J.F. Nye, Oxford University Press, 1985
9. *Dielectric Relaxation in Solids* by A.K. Jonscher, 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

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Ph.D. (Physics): I Semester
SESSION: 2020-2021
Elective Course

PHY EC 143	Advanced Electronic Systems	L	T	P	C
		3	0	1	4

Objective:- Course of advanced Electronic systems designed of Provide basic information about microprocessor architecture, advanced RISC microprocessor and devices.

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.

(Lectures - 12)

UNIT - IV

Design Technology: Automation-Synthesis, Verification - Hardware/Software co-simulation, Simulation Speed, Emulators, Reuses, Design process Models.

(Lectures - 12)

UNIT - V

Devices, Buses, Drivers and Interrupt mechanism: IO devices, Timer and counting devices, serial communication [I²C, 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)

Expected outcome:- The students will leave about microprocessor' memory, design technology and hardware / software simulation.

Essential Readings:

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

Suggested Readings:

3. Embedded system Design (A unified Hardware/Software Introduction) - Frank Vahid & Tony Givargis, Wiley India. 2002

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