Syllabus

w.e.f. 2020-21

(Department of Physics)

Syllabus

for

Ph.D. core-course

GLA University, Mathura
Institute of Applied Sciences and Humanities
Ph.D.(Physics)
SOLID EARTH GEOPHYSICS AND SIEMO ELECTROMAGNETICS
(PPHS0001)

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PART-I

Internal constitution of the earth, characteristics of lithosphere, and asthenosphere, causes of geodynamical processes, geodynamical models, continental drift. Ocean floor spreading, plate tectonics and its geological implications, new global tectonics and plate margin process, oceanic ridges of the triple junction, trenches and inland arcs, geodynamics of Indian subcontinents and formation of Himalayas, 90^0 e ridge.

PART-II

Origin of geomagnetic field, secular variations and westward drift, geomagnetic storms, Earth, s current, sun spot, solar flares, lunar and solar variations, palaeomagnetics studies of rock samples and their applications in geophysics, polar wandering, reversals of geomagnetic field.

PART-III

Focal depth epicenter of earthquakes great Indian earthquakes types and causes of earthquakes volcanic eruptions, seismic zones over Indian plate, earthquakes prediction techniques in India. Laboratory experiments, generation mechanism of seismo- electromagnetic emission and their propagation in crust, atmosphere, and magnetosphere, seismogenic effect in atmosphere, ionosphere and magnetosphere.

References:

1. Introduction to Geophysics, Howell Jr, Franklin, B., McGraw-Hill Series In The Geological Sciences
2. Physics of the earth,Frank D. Stacey, Paul M. Davis, cambridge University Press
3. Plate tectonics and crustal evolution *(4th ed.), Condie, K.C. (1997), Butterworth-Heinemann.*
4. Earth's magnetism, Chapman,S. 2nd Ed, Methuen
5. Core and and geomagnetism, Jack A. Jacobs, Elsevier Science & Technology,

GLA University, Mathura
Institute of Applied Sciences and Humanities
Ph.D.(Physics)
Instrumentation and signal processing
(PPHS0002)

L T P
4 0 0

PART-I

Amplifiers: Audio amplifiers, Power amplifiers, feedback amplifiers operational amplifiers, Filters: law pass, High Pass, band pass, band reject, and notch filters, digital filters, A/D convertors, data acquisition

PART-II

Short electric dipole, field of the short electric dipole, thin linear antenna, Horizontal antenna above a plane ground, vertical antenna above a plane ground, borehole antenna, Yagi –Ude antenna , loop antenna

PART-III

Analog and digital signal recording; mechanism of signal recordings MATLAB; use of data acquisition tool box in data acquisition; Methods of data processing; Cepstral analysis, multifactor analysis, factral analysis, weblet analysis, dynamic Foureir analysis, Principle components analysis.

References:

1. Antennas for all applications, John D. Kraus & Ronald J. Marhefka, Tata McGraw-Hill 3rd Edition.
2. Digital Signal Processing, Alanv.Pppenhien & Ronald W. Schafer, Preason Education, India
3. Digital Filters : Design and Applications, Antoniou Andreas, Tata McGraw-Hill
4. Electromagnetics with applications, John D., Daniel A. Fieisch WCB, Tata McGraw-Hill

GLA University, Mathura

Institute of Applied Sciences & Humanities

Ph.D. (PHYSICS)

Advanced Solid State Physics

(PPHS0003)

L T P

4 0 0

PART-1

Occurrence of non-ideal crystals, Bragg law & Diffraction method, Brillouin zones, Scattering factor, Mono-atomic and diatomic linear chain vibrations, phonon dispersion relation, Specific heat of solids, Debye model, Anharmonic interactions, thermal properties of solids, Electrical and thermal conductivity of metals, Lattice vacancies, Defects in solids, Shear strength of single crystals, Dislocation densities.

PART-1I

Band theory of solids, Quantization of orbitals in magnetic field, De Haasvan Alphen effect, Boltzmann transport equation, lattice conduction, phonon drag, phonon-phonon transition, Magnons, Electron-phonon and electron-electron interaction, BCS theory of superconductivity, Flux Quantisation,High temperature superconductor, Josephson tunneling, Heavy fermions, Electron behavior in non-crystalline solids.

PART-I1I

Quantization of Lattice vibrations, Plasmons and optical phonons, dispersion relation for magnons, Spin waves, Antiferromagnetic and ferromagnetic Sub-lattice magnetization and Specific heat, Fermion fields and Hartee-Fock approximation, Dynamics of electrons in magnetic field, Magneto resistance.

Reference Books:

1. Solid State Physics by C.Kittel.
2. Quantum theory of solids by C.Kittel.
3. Solid State theory by A.J.Decker.
4. Physics of phonons by G.P.Srivastava.
5. Solid State Physics by S.O.Pillai.
6. Crystallography by O.N. Srivastava & A.R.Verma

GLA University, Mathura

Institute of Applied Sciences & Humanities

Ph.D. (PHYSICS)

Nanoscience & Technology

(PPHS0004)

L T P

4 0 0

PART-1

Basic principle of Nanoscience, Nanoparticles (nanos), Nanoclusters, Synthesis and characterization of Nanoparticles & Nanoclusters, Structure of C-60 Bucky- *ball*, Quantum well, Quantum wire and Quantum dots, Carbon Molecules.

PART-II

Structure of Carbon Nanotubes,Kinds of Carbon Nanotubes, Specific surface Area (SSA),Fullerenes, Different forms of solids from Carbon atoms, Synthesis of Carbon Nanotubes,Chemical vapor deposition (CVD),Self Assembly, Continuous CCVD process for Industrial production, Mechanical and thermal properties, Elastic moduli,thermo power in Nanotubes.

PART-III

Band Structure of Nanotubes, density of states, Electronic transport in Nanotubes fibre, Model calculation for thermal and electrical conductivity, Band gap, magnetic properties, polymer nanocomposties, Nanoprobes and Sensors, Nano structures in electronics, Applications of Nanotechnology, principle of Transmission electron Microscope (TEM), Scanning Electron Microscope(SEM).

Reference Books:

1. Science of Engineering Material and Carbon Nanotubes by C.M.Srivastava &C. Srinivasan.
2. Nanotechnology: Basic Science and emerging technology by Mick Wilaon.
3. Introduction to Nano scale science and technology by Ventra Massimilian, Evoy Heflin, James R. (Eds.) 2004, p-632.
4. Introduction to Nano electronics (Science, nanotechnology, Engineering and applications) by VLADIM IR V. Mitin, Dec. 2007.
5. Applied Nanotechnology by Jeremy Ramsden Elsvier, 978-0-8155-2023-8.
6. Nanotechnology in molecular diagnostic: K.K.Jain, Current techniques and Application, Horizon Scientific press, 2006.

Institute of Applied Science and Humanities

Ph.D. (Physics)

Radiation Physics **L T P**

(PPHS0005) **4 0 0**

PART-I

Nuclear nomenclature. Binding energy and semi-empirical mass formula. Radioactive decay. Radioactivity general properties of alpha beta and gamma rays. Law of activity. Law of successive transformation. Natural radioactive series. Radioactive equilibrium. Alpha rays spectra and beta rays spectra. Theory of beta decay, gamma emission, electron captures and internal conversion. Nuclear isomerism. Artificial radioactivity. Nuclear cross section. Elementary ideas of fission and reactors fusion.

PART-II

Interaction of electromagnetic radiation with matter. Exponential attenuation. Thomson scattering. Photoelectric and Compton process and energy absorption. Pair production. Attenuation and mass energy absorption coefficients. Relative importance of various processes.

Interaction of charge particles with matter. Classical theory of inelastic collision with atomic electrons. Energy loss per ion pair by primary and secondary ionization. Dependence of collision energy losses on the physical and chemical state of the absorber. Cerenkov radiation. Electron absorption process. Scattering excitation and Ionization. Radiative collision. Bremsstrahlung Range energy relation. Back scattering.

PART-III

Scope of radiotherapy benign and malignant tumours. Tissue tolerance dose and tumour lethal dose. Dose Fractionation. Palliative and curative therapy. Spectral distribution of X-rays and effect of filtration. Output calibration procedures by backscatter and central axis depth doses. Isodose curves wedge filters. Shielding blocks and compensators. Treatment planning in teletherapy. Role of computers. Correction for body inhomogeneity contour shapes and beam obliquity. Rotation therapy and tissue air ratio. Tissue maximum ratio

Reference Books

1. Preston and Bhaduri: Structure of the Nucleus
2. Krane: *Introductory nuclear physics*
3. Glenn F. Knoll-Radiation Detection and Measurement
4. Arthur Beiser: Concepts of Modern Physics
5. F M Khan-Physics of Radiation Therapy

GLA University, Mathura

Institute of Applied Science and Humanities

Ph.D. (Physics)

Radiation Therapy

(PPHS0006)

L T P

4 0 0

PART-I

Telegamma therapy. Advantage over conventional X-ray therapy. Megavoltage X-rays therapy. Electron contamination. Particulate beam therapy. Relative merits of electron, neutron, X-ray and gamma ray beams. Neutron captures therapy. Modern trends. Heavy ion therapy.

PART-II

Quality assurance in radiation therapy. Necessity for accuracy in clinical dosimetry. Check of gantry and collimator movements and settings. Alignment of optical and radiation fields. Isocentric shift, interlocks, control panel displays. Cough movements. Shutter timer accuracy. Check of beam directing devices.

PART-III

Passage of heavy charged particles through matter. Energy loss by collision. Range energy relation. Bragg curve. Specific ionization. Stopping Power. Bethe Block formula.
Interaction of neutron with matter. Scattering Interactions .Neutron induced nuclear reactions. Action of radiation on living cells. Physical Factor influencing somatic effect. Dependence on dose rate, type and energy of radiation. Effect of radiation on skin and blood forming organs. Radiation Carcinogenesis.

Reference books

1. F M Khan-Physics of Radiation Therapy
2. Johns and Cunningham : Physics of Radiology
3. E J Hall: Radiobiology for Radiologist
4. IAEA Technical Report Series 398
5. IAEA Technical Report Series 430

GLA University, Mathura
Institute of Applied Sciences and Humanities
Ph.D (Physics)
Plasma Electrodynamics

(PPHS0007) **LTP**
400

Part-I

Debye length, plasma oscillations, collisions; Plasma response to dc and ac electric fields; Plasma response to ac electric field in the presence of dc magnetic field; Electromagnetic wave propagation and reflection/ refraction from plasmas, metals and semiconductors; em wave propagation in magnetized plasma (Alfven wave, whistler wave, electron cyclotron wave etc.)

Part-II

Plasma production; Single particle motion in electric and magnetic fields, mirror machine; Surface plasma wave over plasma boundary

Part-III

Plasma wave, ion acoustic wave, two stream instability, laser driven fusion, applications in space

References :

1. Basic Plasma Physics, Basudev Ghosh, Narosa Publishing House (2014).
2. Introduction to plasma physics and control fusion, F. F. Chen, Springer (1984).
3. Interaction of electromagnetic waves with electron beams and plasmas, C.S. Liu and V K Tripathi, World scientific publishing Co. Pvt. Ltd., Singapore (1994),
4. Electromagnetic theory for telecommunications, CS Liu and V K Tripathi, Cambridge University Press, India. Pvt. Ltd. (2007).

GLA University, Mathura

Institute of Applied Sciences and Humanities
Ph.D. (Physics)

Non linear Phenomenon in Plasmas
(PPHS0008)

Part-I [14 Lecture]

Heating of un-magnetized and magnetized plasmas by high power electromagnetic waves; Ponderomotive force, nonlinear plasma permittivity, self-focusing of laser beam in collisional and collisionless plasmas.

Part-II [14 Lecture]

Laser excitation of plasma wave, acceleration of electron by plasma wave, laser beat wave heating, harmonic generation, parametric amplifier and parametric instabilities (SRS SBS).

Part-III [14 Lecture]

Laser interaction with carbon nanotubes and applications; Laser ablation of materials. High power radio wave modification of ionosphere, ELF generations.

References:

1. Introduction to plasma physics and control fusion, Springer, Francis F. Chen
2. Introduction of Electromagnetic waves with electron beams and plasma, World scientific publishing co. pvt. Ltd., Singapore, by CS Liu and V K Tripathi.
3. Electromagnetic theory for telecommunications, Cambridge University Press, India. Pvt. Ltd by CS Liu and V K Tripathi.
4. Self-focusing of laser beams TATA- McGraw-Hill Publishing Co. ltd., New Delhi, by M. S. Soda, A K Ghatak, and V K Tripathi.
5. Related review articles.

Advanced Cosmology

(PPHS0009)

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Unit I: Introduction:

Dynamics of expanding Universe and its matter/energy content; Robertson-Walker metric; Co-moving co-ordinates; Spatial geodesics; Number conservation; Energy & momentum conservation; Cold matter, hot matter and vacuum energy; The Thermal History of the Universe (Hot Big Bang model); Introduction to Inflationary Theory.

Unit II: Homogeneous and isotropic universe models

The Cosmological Principles; Friedmann-Robertson-Walker Model; Dynamics of Homogeneous and Isotropic Universe; Cosmological redshift and the Hubble law; Radiation dominated universe model; Matter dominated universe model; The gravitational lens effect; Redshift-luminosity relation; Cosmological Horizon.

Unit III: Anisotropic and Inhomogeneous universe models

The Bianchi type I universe model; The Kasner solutions; The energy-momentum conservation law in anisotropic universe; Models with perfect fluid; Inflation through bulk viscosity; Universe with dissipative fluid; The Lamaitre-Tolman-Bondi universe models

References Books:

1. Weinberg, S., Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, 1972, John Wiley & Sons
2. Weinberg, S., Cosmology, Oxford University Press
3. Oyvind Gron & S. Hervik: Einstein's General Theory of Relativity: With Modern Application in Cosmology, Springer

Advance Cosmology – II

(PPHS0010)

To be framed

Advance Nuclear Physics – I

(PPHS0011)

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Unit – I: General Properties of Nuclei

Parametrisation of nuclear masses (Weizsaecker formula), Properties of nuclear matter, Nuclear stability, Alpha, beta and gamma decays with selection rules, Particle emissions, Nuclear fission and fusion processes, Production of nuclear energy and working of a reactor.

Unit – II: Nuclear Structure and Reactions

Fermi gas model, Shell model, Collective rotational and vibrational models of nuclei, Microscopic description of nuclei using Hartree-Fock theory.

Quarks and Leptons and their Interactions, Structure of Nucleon

Lepton and quark families, Different types of interactions, Neutrino interaction with matter.

Unit – III: Nuclear Astrophysics

Abundance of the elements in the solar system, Nucleo-synthesis, r-, s- and p-processes, Neutron resonant and non-resonant reactions, Hydrogen burning, Helium burning and production of carbon and oxygen.

References Books:

1. M. A. Preston and R. K. Bhaduri, (1982), Structure of the Nucleus, Addison-wesley,
2. M. K. Pal, (1982), Theory of Nuclear Structure, East-west Press.
3. W. E. Burcham and M. Jobes, (1998), Nuclear and Particle Physics, Addison-Wesley,
4. Rolfs and Rodney, Cauldrons in Cosmos: Nuclear Astrophysics, Chicago University Press

Advance Nuclear Physics – II

(PPHS0012)

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Unit – I: Nuclear Techniques and Applications - I

Particle Induced X-ray Emission (PIXE), Rutherford Back Scattering (RBS), Neutron Activation Analysis (NAA) and their applications, Gamma-ray Spectroscopy: Energy, Intensity, Angular correlation and Coincidence measurements.

Unit – II: Nuclear Techniques and Applications - II

Lifetime measurements using Doppler Shift Attenuation and Plunger techniques, Charged particles spectroscopy, Time of flight (ToF) technique, Positron Annihilation and Mossbauer Spectroscopy.

Unit – III : Instrumentation

Production of beam of charged particles using Linear Accelerator and Tandetron Accelerator; Production of neutron using accelerator.

Radiation detection using Si(Li), HPGe, Si-Surface Barrier and Scintillator detectors; Energy and timing signal processing using Pre-Amplifier, Amplifiers, CFD and TAC; Data Acquisition using MCA, FPGA based systems.

References Books:

1. S N Ghoshal (1998) Atomic and Nuclear Physics Vol. II, S Chand & Company Ltd.
2. H. Ejiri and M. J. A. de Voigt (1989), Gamma-ray and Electron Spectroscopy in Nuclear Physics, Oxford Studies in Nuclear Physics, Clarendon Press.
3. Glenn F. Knoll (1979), Radiation Detection and Measurements, John Wiley & Sons.
4. K. Siegbahn (1965) Alpha-, Beta- and Gamma-Ray Spectroscopy Vol. 2, North-Holland Publ. Company.
5. W. R. LEO (1987) Techniques for Nuclear and Particle Physics Experiments, Springer Verlag.