AcSIR-CSIR Physical Sciences Course Work Syllabus

100 level courses

PHY-NEIST-1-3901 (Core)
Research Methodology: 1-0-0-1

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.
The concerns of science, The objectives of scientific research, The problem of the 'Empirical basis', Scientific objectivity and subjective conviction, Causality, Explanation and the deduction of predictions, Theoretical systems, Inductive logic and probability logic, Verification and falsification, Discovery and justification, The Path of science.

PHY-NEIST-1-3902 (Core)
Geophysical, Geological & Geochemical Methodologies: 1-0-0-1

An introduction to Applied Mathematics Summaries of basic concepts like Determinants, Vector analysis, Matrix analysis, Complex numbers, Method of least squares, Finite differences and Partial fractions. Fourier series and Fourier integral, Fourier Transforms, Laplace transforms, Linear systems, Digital systems and z-transforms.
An introduction to Exploration Geophysics: The questions frequently faced by the geophysicists, the nature of geophysical problems, Fields of Exploration Geophysics: Regional geophysics, Oil and gas geophysics, Ore geophysics, Ground water geophysics, Engineering geophysics, Borehole Geophysics and Reservoir geophysics

Elements of Surveying: Objective of surveying and its importance, Classification, principles of surveying, Application of surveying in geophysical exploration, mapping techniques, contouring, Different types of contouring,

Elements of Geology: Minerals and Rocks, Igneous Rocks, Weathering and sedimentary rocks, Metamorphic rocks, Volcanic eruptions, Earthquakes, Crustal deformation and Mountain building, Earth History, Energy and Mineral resources, Mass wasting, Deserts, Surface water & ground water, Coastal and marine geology, Glaciations and Ice ages, Global changes.

Theory, principles and applications of Global Positioning System (GPS), Simple uses of a GPS tool.

PHY-NEIST-1-3903 (Core)
Basics in Seismology: 1-0-0-1

Elasticity theory and seismic waves: Elastic, anelastic and plastic behavior of materials, the stress matrix, the strain matrix, the elastic constants, generalized Hooke's law, different types of elastic waves and their propagation characteristics, equations of motion of seismic body waves, Attenuation and dispersion of seismic waves, free oscillations of the earth.
Instruments: Amplitude and phase characteristics of seismometers, shortperiod, longperiod and broad band seismometers, analysis of seismograms and identification of various phases on the seismograms, basic principle of strong motion instrument.

Ray characteristics and related parameters for horizontally and spherically stratified earth, basic principles of seismic tomography and receiver function analysis, location of the epicenter of an earthquake, global seismicity, elastic rebound theory, faultplane solutions and related interpretation, reflections and refractions in the earth's interior, models of the earth's internal structure.

Earthquake monitoring and prediction: Seismic networks and arrays, standalone and telemetry systems, study of microearthquakes and induced seismicity, Earthquake prediction: Dilatancy theory, shortterm, middleterm and long term prediction.

PHY-NEIST-1-3904 (Core)
Physical Geology: 1-0-0-1

Planet earth & geological processes, early history of earth & geological records, Continental drift, sea-floor spreading, plate tectonics and continent & ocean building processes

200 level courses

PHY-NEIST-2-3901 (Elective)
Numerical Analysis & Computer Programming: 1-1-1-2

Numerical solution of ordinary differential equations (Solution by Taylor's Series, Picard's Method of Successive Approximations, Euler's Method, Runge-Kutta Methods, Adams-Moulton Method, Milne's Method), Numerical solution of partial differential equations (Laplace's equation, Jacobi's Method, Gauss-Seidel Method, Iterative methods for the solution of equations) , Numerical Solution of Integral equations (Finite difference methods, A method of degenerate Kernels, Method of Invariant Imbedding, Method using generalized quadrature)
Fundamental concepts related to Computer Programming: Architecture of digital computers, number systems, data representation, binary arithmetic, Classification and overview of operating system modules; Introduction to UNIX and LINUX operating systems, Window environment, algorithm and flowcharts.

FORTRAN: Control structures- selective and repetitive,, arrays, format statements; subprogram functions, subroutines, DATA, SAVE, COMMON and EQUIVALENCE statements; file processing; additional data types, logical, double precision and complex types.

C: Introduction, constants, variables and data types, operators and expressions, I/O operations, decision making and branching; decision making and looping; arrays, structures and unions, user defined functions, pointers, file management, dynamic allocations and linked lists, the preprocessors.

PHY-NEIST-2-3902 (Elective)
Tectonics & Geodynamics: 2-0-0-2

Orogeny, epeirogeny and isostasy. Concept and classification of tectonic associations. Structure of the Alps and Himalayas. Continental Extensional Tectonics. Tectonic classification of India. Tectonics on a sphere. Palaeomagnetism and past plate motions, with special reference to the Indian plate. Heat flow and geothermics: calculation of equilibrium and evolving geotherms. Plate cooling models. Driving forces for plate motions. The oceanic lithosphere - ridges, transform faults, trenches and oceanic islands. The continental lithosphere: cratons, sedimentary basins, continental margins and rift zones. Mantle petrology and chemical composition. Silicate phase transitions and correlation with mantle discontinuities. Structure of the lower mantle and core. Models of mantle convection: evidence for single and double-layered convection.

PHY-NEIST-2-3903 (Elective)
Electrical and Electromagnetic methods: 2-0-0-2

Low frequency electrical properties of soils and rocks: Resistivity (& induced Polarization) methods, Electromagnetic methods: Case Studies of electrical and electromagnetic methods in environmental and engineering studies.
High frequency electrical geophysics: High frequency electrical properties of soils and rocks, Ground penetrating radar (GPR) method, Case Studies of ground penetrating radar in environmental and engineering studies.

PHY-NEIST-2-3904 (Elective)
Geomagnetism: 2-0-0-2

Earth’s magnetic field – elements, origin and units of measurement, magnetic susceptibility of rocks and measurements, magnetometers, Land, airborne and marine magnetic surveys, corrections, preparation of magnetic maps, upward and downward continuation, magnetic anomalies-geometrical shaped bodies, depth estimates, Image processing concepts in processing of magnetic anomaly maps; Interpretation of processed magnetic anomaly data.

300 level courses

PHY-NEIST-3-3901 (Elective)
Gravity and Magnetics : 2-0-0-2

The Earth's gravitational field and its relation to gravity exploration, Gravitational effects over subsurface bodies having discrete shapes, Instruments for measuring gravity on land, at sea and into the boreholes, Gravity measurements on land, at sea and airborne gravity surveys.
Magnetism of the earth, Magnetic susceptibility of rocks, Magnetic effects from buried magnetic bodies, Instruments used for magnetic measurements, Magnetic surveys on land, Marine and airborne magnetic data collection.

PHY-NEIST-3-3902 (Elective)
Hazards Perception & Risk analyses: 2-0-0-2

Introduction to geohazards (volcanoes, tsunamis, ground shaking & landslides). Fundamentals of hazard assessment and risk.

PHY-NEIST-3-3903 (Elective)
Geomorphology & Neotectonics: 2-0-0-2

Energy flow in geomorphic system and landforms, Structural control & landscape evolution, dynamic equilibrium and topographic response to tectonic and climatic forcing, fluvial geomorphic systems, Quaternary geomorphology, application of geomorphology – methods & techniques, Tectonic geomorphic marker & dating techniques, tectonics & topography, river terrace genesis.

PHY-NEIST-3-3904 (Elective)
Stratigraphic principles of sedimentation: 2-0-0-2

Stratigraphic principles & units, Nature of stratigraphic records, Depositional processes & sedimentary structures, Sedimentary basin environment and facies.

400 level courses

PHY-NEIST-4-0001 (Core)
Project Proposal writing & Presentation: 0-0-4-2

PHY-NEIST-4-0002 (Core)
Review Article Writing & Presentation: 0-0-4-2

PHY-NEIST-4-0003 (Core)
CSIR-800 Societal Programme: 0-0-8-4