Introduction

Content: B.Sc. (Hons.) Geology
Programme Offered:
Being a fast economically developing country with increasing population, the nation is faced with innumerable problems r
to depleting natural resources, acute shortage of energy, natural disasters and many types of environmental hazards. Tw
third of Indian subcontinent lies in the seismic zones of moderate to severe intensity. Solution and management of many
these problems can be met by understanding the earth more intensively and extensively, which could be achieved by pur
the course in Geology. It is an exciting course related to natural science and has both fundamental as well as applied utili
especially in the large ticket infrastructure projects.
Programme Outcome:

Learning Outcome based approach to Curriculum Planning

>> Aims of Bachelor's degree programme in (CBCS) B.SC.(HONS.) GEOLOGY

Content: Through innovative classroom teaching with through ICT tools models and demonstrations, students develop an
ability of perceiving the geological processes which generally operate at time scales ranging from days to billions of years
the fundamental premise that the present is the key to past. It prepares students to develop their logical thinking and
communication skills with the science based imaginative perception. Ethical societal context of applied geology in econom
well as environmental context is the fundamental balance which a geology graduate student is expected to acquire.
Propagating their thoughts through presentations and participation in various related societies enhance their cultural- soc
national centric thought.

Graduate Attributes in Subject

>> Disciplinary knowledge

Content: After the successful completion of B.Sc. (Honours) course pupil are eligible for admission to courses M. Sc./ M. T
/M. Sc. Tech. in Geology, Applied Geology, Remote Sensing, Geo-informatics, Environmental science, Petroleum geology a
Mining Engineering at various universities of India and abroad. They are also eligible for admission to B. Ed. at various
universities. Geology is one of the optional subjects for civil services, Forest Services and similar examinations.
PG degree in Geology, make them eligible for UPSC examination to enter Geological Survey of India (GSI) and the Centra
Ground water Board (CGWB). Para-military forces are also in constant need of Geologists. Experienced and well educated
Geologists can also apply for top positions in the government, industry and education sector.

Graduate Attributes in Subject

>> Disciplinary knowledge

Content: Geology is everywhere in our daily lives and finds its potential application in various fundamental spheres of life
including exploration and management of mineral and energy resources, ground water and surface water, land use and
environment hazards viz. floods, landslides and seismicity, volcanoes and tsunamis, environmental protection by monitori
waste disposal sites including nuclear waste etc. Understanding our Earth has never been more important. Because Earth
science is so intertwined with our daily lives, our discipline evolves as the years go by; responding to the needs of what s

compels us to understand.
These diverse needs require a strong understanding of the basic concepts and principles of Earth science. Although the tir change and the applications vary, understanding the basic composition of geologic materials, their origins, and how the p acts as a physical and chemical system is imperative in understanding Earth. Everything from climate change, to the abundance of groundwater, to the frequency of large storms and earthquakes, to the location and cost of extracting rare elements from Earth is relevant. It is a simple fact that as the complexity of these challenges increases, the need for well educated geologists to provide scientific data and advice in extracting, conserving and managing earth's natural resources assume more and more importance.

Programme Learning Outcome in course

Content: PSO1. To understand the nature and origin of various component of earth system including planetary objects, its origin, its components and operative processes in past and present
PSO2. To acquire theoretical framework for understanding the nature of geological material including rocks, minerals and fossils
PSO3. To integrate observations and theory for describing natural geological process in past and present as well to unders the time scales of geological processes
PSO4. To apply the knowledge of the material and processes in mineral and energy exploration, oceanography, soil and w resource
PSO5. To apply the knowledge gained through field work for greater understanding of earth and related phenomena.

Earth System Science
(GEOL CC1)
Core Course - (CC) Credit:6

Course Objective(2-3)

Introduction to the Earth and other planets in the solar system in terms of surface features and processes

Principles of earth system studies

Interactions between lithosphere, hydrosphere, biosphere and atmosphere

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Course Learning Outcomes

After completion of this course students will be able to understand and comprehend the connectivity and dynamics of atmosphere, lithosphere, hydrosphere of the Earth. A through understanding of Geology, its various branches and overall scope of Earth Science will be possible through this course.

Unit 1

Holistic understanding of dynamic planet 'Earth' through Astronomy, Geology, Meteorology and

Oceanography. Introduction to various branches of Earth Sciences.

General characteristics and origin of the Universe, Solar System and its planets. The terrestrial and Jovian planets. Interior of the earth. Meteorites and Asteroids

Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters and its age. E Earth's Magnetic Field an its origin. Paleomagnetism.

Unit 2

Plate Tectonics

Concept of plate tectonics, sea-floor spreading and continental drift

Earthquake and earthquake belts

Volcanoes- types, products and their distribution.

Unit 3

Hydrosphere and Atmosphere

Oceanic current systems. Warm and cold ocean currents and their distribution . Impact of ocean currents on climate.

Wave erosion and beach processes

Atmospheric circulation

Weather and climatic changes

Earth's heat budget. Soils- processes of formation, soil profile and soil types.

Unit 4

Understanding the past from geologic records

Nature of geologic records

Standard Geological time scale and introduction to the concept of time in geological studies

Introduction to geochronological methods and their application in geological studies

History of development in concepts of uniformitarianism, catastrophism and neptunism

Prinipals of stratigraphy . Physiographic divisions of India

Practical

Study of major geomorphic features and their relationships with outcrops through physiographic models. Detailed study of topographic sheets and preparation of physiographic description of an area

Study of distribution of major dams on map of India and their impact on river systems

Study of major ocean currents of the World

References

1. Duff, P. M. D., & Duff, D. (Eds.). (1993). *Holmes' principles of physical geology*. Taylor & Francis.

2. Gross, M. G. (1977). Oceanography: A view of the earth.

Additional Resources:

2. Emiliani, C. (1992). *Planet earth: cosmology, geology, and the evolution of life and environment*.

Cambridge University Press.

Teaching Learning Process

Lectures, Practicals, Seminars, Tutorials, Assignments

Assessment Methods

Tests, Quiz, Debates and presentations

Keywords

Atmosphere, Lithosphere, Hydrosphere, Biosphere, Planets

Economic Geology
(GEOL CC11)
Core Course - (CC) Credit:6

Course Objective(2-3)

Create knowledge of ore forming processes in time and space

Relating petrological principles to the ore genesis

India's ore mineral distribution

Course Learning Outcomes

Student will be able to distinguish between economic and uneconomic natural resources as well different types of economic minerals. Student will also understand the basic procedure of economic evaluation of mineral deposits. The processes of ore deposit formation will form the base of the course. Distribution of Indian mineral deposits, national mineral policy as well as the modern method of classifying mineral deposits (UNFC) will also be taught making the student ready for current challenges in the non-renewable natural resource context.

Unit 1

Ores and gangues

Ores, gangue minerals, tenor, grade and lodes

Resources and reserves-Economic and Academic definitions

Metallic, industrial and strategic minerals

Unit 2

Mineral deposits and Classical concepts of Ore formation

Mineral occurrence, Mineral deposit and Ore deposit

Historical concepts of ore genesis: Man’s earliest vocation-Mining

Plutonist and Neptunist concepts of ore genesis.

Unit 3

Mineral economics

Methods of economic evaluation of resources and reserves, characterization curve, order of magnitude and other economic evaluations, pre-feasibility and feasibility studies, cash flow, mineral conservation, United Nations Framework classification (UNFC), National mineral policy.

Unit 4

Structure and texture of ore deposits

Concordant and discordant ore bodies

Endogenous processes: Magmatic concentration, skarns, greisens, and hydrothermal deposits Exogenous processes: weathering products and residual deposits, oxidation and supergene enrichment, placer deposits.

Unit 5

Ore grade and Reserve, assessment of grade, reserve estimation.

Unit 6

Distribution of ores and minerals.

Metallogenic provinces and epochs.

Important deposits of India including atomic minerals Non-metallic and industrial rocks and minerals, in India. Introduction to gemstones.

Practical

Megascopic identification

Study of microscopic properties of ore forming minerals (Oxides and sulphides).

Preparationof maps: Distribution of important ores and other economic minerals in India.

Mineral Economics: Cut-off grade, weighted average, life of mine, dilution factor related calculations.

References

1. Chatterjee, K. K.: An Introduction to Mineral Economics
2. Sinha, R K. and Sharma. N. L.: Mineral Economics
3. Bateman, A.M. and Jensen, M.L. (1990) Economic Mineral Deposits. JohnWiley.
4. Evans, A.M. (1993) Ore Geology and Industrial minerals. Wiley
5. Laurence Robb. (2005) Introduction to ore forming processes.Wiley.
6. Gokhale, K.V.G.K.and Rao, T.C. (1978) Ore deposits of India their distribution and processing, Tata-McGraw Hill, New Delhi.
7. Deb, S. (1980) Industrial minerals and rocks of India. Allied Publishers.
8. Sarkar, S.C. and Gupta, A.(2014) Crustal Evolution and Metallogeny in India. Cambridge Publications.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Ore genesis, magmatic deposits, cut-off grade, economic provinces, metallogeny and time

Elements of Geochemistry (GEOL CC5)

Core Course - (CC) Credit:6

Course Objective(2-3)

Develop an understanding of the chemical nature of earth and other planetary material.

To relate mineralogy, geochemistry and bulk chemistry.

Course Learning Outcomes

By attending this course student will be able

1. to understand evolution of the early Earth from proto-planetary material and its differentiation to present day state.
2. to describe the composition of the Earth´s main geochemical reservoirs.
3. to understand how chemical weathering of minerals and rocks control the composition of sediments/soil and natural water.

Unit 1

Origin of chemical elements and stellar evolution. Abundance of elements in cosmos, solar system and earth. Meteorites, Distribution of elements in core, mantle, crust.

Unit 2

Introduction to properties of elements: The periodic table Chemical bonding, states of matter and atomic environment of elements, geochemical classification of elements.

Unit 3

Geochemistry of igneous rocks: geochemical variability of magma and its products. Near surface geochemical environment: Eh-pH diagram; Chemical weathering of minerals and rocks.

Unit 4

Concept of radiogenic isotopes in Geochronlogy.

Practical

Geochemical data analysis and interpretation of common geochemical plots.

References

1. Mason, B (1986). Principles of Geochemistry. 3

rd

Edition, Wiley New York.2. Rollinson H. (2007) Using geochemical data-evaluation. Presentation and interpretation. 2

nd

Edition. Publisher Longman Scientific & Technical.

3. Walther John, V., 2009 Essentials of geochemistry, student edition. Jones and Bartlett Publishers

4. Albarede, F, 2003. An introduction to geochemistry. Cambridge University Press.

5. Dickin' A. P., 1995,Rdiogenic Isotope Geology, Cambridgy UniversityPress

6. Faure, G., 1986. Principle of Isotope Geology, J. Wiley & Sons.

7. Henderson, P., 1982. Inorganic Geochmistry, Pergamon Press, Oxford.

4. Krauskopf, K. B., 1979 Introduction to Geochmistry. McGraw Hill.

8. Mason, B. 1982 *Principles of Isotope Geology, J. Willey* &Sons.

9. Geochemistry by William M White, Wiley-Blackwell (2103).

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Crystal chemistry, geochemical differentiation, geochemical cycles, crustal abundances,

Engineering Geology
(GEOL CC13)
Core Course - (CC) Credit:6

Course Objective(2-3)

Develop an understanding of significance of geology in major engineering projects.

Necessity of geological input in designing of dams, tunnels, roads etc.

Course Learning Outcomes

1. Significance of geology in major engineering projects
2. Method of assessing geological perspective of major infrastructure projects
3. Rock properties related to the strength and bearing capacities of rocks and soils
4. Learning major techniques for ameliorating engineering properties of earth material
5. Understanding the effect and relationship of natural hazards on engineering projects

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Unit 1

Geology vs. Engineering, Role of Engineering geologists in planning, design and construction of major man-made structural features.

Unit 2

Site investigation and characterization.

Unit 3

Foundation treatment;Grouting, Rock Bolting and other support mechanisms.

Unit 4

Intact Rock and Rock Mass properties

Rock aggregates; Significance as Construction Material

Unit 5

Concept, Mechanism and Significance of Rock Quality Designation (RQD) Concept, Mechanism and Significance of:

a.Rock Structure Rating(RSR)

b. Rock Mass Rating(RMR)

c. Tunneling Quality Index (Q)

Geological, Geotechnical and Environmental considerations for Dams and Reservoirs

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Unit 6

Practical

1. Computation of reservoir area, catchment area, reservoir capacity and reservoir life.
2. Merits, demerits & remedial measures based upon geological cross sections of project sites.
3. Computation of Index properties of rocks.
4. Computation of RQD, RSR, RMR and 'Q

References

1. Krynin, D.P.and JuddW.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ).
2. Johnson, R.B. and De Graf,J.V.1988. Principles of Engineering Geology, John Wiley.
3. Goodman, R.E., 1993. Engineering Geology:Rock in Engineering constructions. John Wiley& Sons, N.Y.
4. Waltham, T.,2009. Foundations of Engineering Geology(3rd Edn.)Taylor & Francis.
5. Bell:F.G-, 2006.Basic Environmental and Engineering Geology Whittles Publishing.
6. Bell, .F.G, 2007.*Engineering Geology,*Butterworth-Heinema.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations

Keywords

Regional and detailed mapping, Rock mass rating and rock quality designation, foundation, grouting

Geomorphology
(GEOL CC10)
Core Course - (CC) Credit:6

Course Objective(2-3)

The main aim of this course is to 1) learn about the fundamentals of Geomorphology, 2) learn interaction betweer intrinsic and extrinsic processes, and 3) learn to identify and map landforms.

Course Learning Outcomes

In this course a student will learn about 1) theadvantages to study geomorphology, 2) fundamentals of working of earth surface processes, and 3) various geomorphic techniques, 4) geomorphology of India, and 5) extraterrestrial landforms.

Unit 1

Introduction to Geomorphology:

Geosphere-Hydrosphere-Biosphere,

Unifying concepts

Unit 2

Geoid, Topography, Hypsometry, Global Hypsometry, Major Morphological features

Large Scale Topography - Ocean basins, Plate tectonics overview, Large scale mountain ranges (with emphasis on Himalaya)

Unit 3

Surficial Processes and geomorphology,

Weathering and associated landforms, Hill slopes Glacial, Periglacial processes and landforms, Fluvial processes and landforms, Aeolian Processes and landforms, Coastal Processes and landforms, Landforms associated with igneous activities

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Unit 4

Dating Methods,

measuring rates; Rates of uplift and denudation, Tectonics and drainage development, Sea-level change, Long-term landscape development

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Unit 5

Overview of Indian Geomorphology; Introduction to Extraterrestrial landforms

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Practical

- Reading topographic maps
- Concept of scale
- Preparation of a topographic profile
- Preparation of longitudinal profile of a river
- Preparing Hack Profile and Calculating Stream length gradient index
- Morphometry of a drainage basin - Calculating different morphometric parameters
- Preparation of geomorphic map

References

1. Robert S. Anderson and Suzzane P. Anderson (2010): Geomorphology - The Mechanics and Chemistry of Landscapes. Cambridge University Press.

2. Paul R. Bierman and D.R. Montgomery (2014): Key Concepts in Geomorphology. W.H. Freeman and Company Publishers.

3. M.A. Summerfield (1991) Global Geomorphology. Wiley & Sons.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Landforms, tectonics. Geoid, Surface processes

Hydrogeology
(GEOL CC14)
Core Course - (CC) Credit:6

Course Objective(2-3)

To understand about the nature, occurrence and movement of groundwater in geological context. To develop ba
understanding about ground water exploration and management.

Course Learning Outcomes

The course will introduce students to the fundamental concepts of hydrogeology. They will learn about occurrence and movement of groundwater, aquifers and their parameters, groundwater exploration methods, aspects of groundwater chemistry and groundwater management.

Unit 1

Scope of hydrogeology and its societal relevance,

Hydrologic cycle: precipitation, evapo-transpiration, run-off, infiltration and subsurface movement of water,

Rock properties affecting groundwater, Vertical distribution of subsurface water,

Types of aquifer, aquifer parameters, anisotropy and heterogeneity of aquifers.

Unit 2

Darcy's law and its validity,

Intrinsic permeability and hydraulic conductivity,

Groundwater flow rates and flow direction,

Laminar and turbulent groundwater flow.

Unit 3

Basic Concepts (drawdown; specific capacity etc),

Elementary concepts related to equilibrium and non-equilibrium conditions for water flow to a well in confined and unconfined aquifers,

Surface-based groundwater exploration methods.

Unit 4

Physical and chemical properties of water and water quality,

Introduction to methods of interpreting groundwater quality data using standard graphical plots,

Sea water intrusion in coastal aquifers.

Unit 5

Basic concepts of water balance studies, issues related to groundwater resources development and management,

Groundwater level fluctuations,

Rainwater harvesting and artificial recharge of groundwater.

Practical

Preparation and interpretation of water level contour maps and depth to water level maps,

Preparation and analysis of hydrographs for differing groundwater conditions ,

Graphical representation of chemical quality data and water classification (C-S and Trilinear diagrams),

Simple numerical problems related to: determination of permeability in field and laboratory, Groundwater flow, Well hydraulics etc.

References

Todd, D. K. 2006. Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y.

Karanth K.R., 1987, Groundwater: Assessment, Development and management, Tata McGraw- Hill Pub. Co. Ltd.

Additional Resources:

Davis, S. N. and De Weist, R.J.M. 1966. Hydrogeology, John Wiley & Sons Inc., N.Y.

Raghunath, H.M. 2007. Groundwater, Third Edition, New Age International Publishers.

Syed Tajdarul Hassan. 2017. Introduction to Hydrology. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank . 2017. Aquifer Properties. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank. 2017. Darcy's law. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank. 2017. Assessment of groundwater quality. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Syed Tajdarul Hassan. 2017. Hydraulic Head, Fluid Potential, Reynolds number and Pumping Tests-I. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Syed Tajdarul Hassan. 2017. Hydraulic Head, Fluid Potential, Reynolds number and Pumping Tests-II. E-PG Pathshala, UGC, MHRD, Govt. of India. Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates, Project assignment and Presentations.

Keywords

hydrogeology;

aquifer parameters; Darcy’s law; well hydraulics; groundwater exploration; groundwater quality; sea water intrusion; water balance.

Igneous Petrology
(GEOL CC6)
Core Course - (CC) Credit:6

Course Objective(2-3)

To develop an understanding of the types of magma as well as types of igneous rocks.

Magma generation in relation to the geodynamic setting and its relation with the size and fabric of igneous rocks

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Course Learning Outcomes

On completion of the course, the student should be able to:

a) determine the evolution of igneous rocks using petrographical, mineralogical and geochemical indices

b) describe magmatic rocks from a plate tectonic point of view.

Unit 1

Introduction to Igneous Petrology

Scope of Igneous petrology, classification of Igneous rocks, igneous textures, igneous structures.

Unit 2

Introduction to silicate melts and magmas

Physical properties of magma, the ascent of magmas, magmatic differentiation.

Unit 3

Introduction to Igneous Phase diagrams

The phase rule, the lever rule, Two Component systems involving melt: Binary system with a Eutectic,Binary system with a peritectic,Binary system thermal barrier,Binary system with solid solution, Binary system with partial

solid solution.

Unit 4

The chemistry of Igneous rocks

Modal mineralogy, normative mineralogy, variation diagrams based on major elements, major element indices of differentiation,identification of differentiation processes using trace elements, application of radioactive isotopes in igneous petrology.

Unit 5

Introduction to igneous environments

Basalts and mantle structure, Oceanic magmatism, Igneous Rocks of Convergent Margins and Igneous Rocks of the Continental Lithosphere.

Practical

a) Study of important igneous rocks in hand specimens and thin sections- granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite.

b) Calculation of Norm & Classification of Igneous Rocks

c) Plotting and interpretation of variation diagrams.

d) Igneous rock occurrences in Indian context.

References

1. Frost, B. R. and Frost, C. D., (2013)Essentials of Igneous and Metamorphic Petrology Cambridge University Press.

2. Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. CambridgeUniversity Press.

3. Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.

4. Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation.Routledge.

5. Sen, G. (2014) Petrology Principles and Practice,Springer-Verlag Berlin Heidelberg

6. Bose M.K. (1997). Igneous Petrology.

7. Wilson, M. (1989) Igneous Petrogenesis,Springer-Verlag Berlin Heidelberg

8. Janoušek, V., Moyen, J.-F., Martin, H., Erban, V., Farrow, C. (2016) Geochemical Modelling of Igneous Processes – Principles And Recipes in R LanguageBringing the Power of R to a Geochemical Community,Springer-Verlag Berlin Heidelberg

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Magma and lava, granite, basalt, batholith, large igneous province, plate tectonics

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Metamorphic Petrology
(GEOL CC8)
Core Course - (CC) Credit:6

Course Objective(2-3)

Learn to consider metamorphic rocks as chemical system as well as major variables affecting the system

To be able to appreciate the deduction of P-T from metamorphic mineral assemblages

To understand significance of mineral assemblages and fabric in relation to the geodynamic setting

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Course Learning Outcomes

1. Understanding nature of metamorphic rocks in contrast to igneous and sedimentary rocks

2. Applying phase rule as a basic tools in study of these rocks and through learning control of bulk composition on assemblage development

3. Identifying equilibrium mineral assemblages through textural and mineralogical observations

4. Plotting the quantitative as well as qualitative mineral and mineral assemblage data to interpret the discontinuous reactions and to infer the nature of continuous reactions

5. Relate and understand mineral assemblages and texture for tectonic and geodynamic interpretations especially in mountain building.

Unit 1

Metamorphism:Phase rule and Goldschmidt mineralogical phase rule, pure and impure phases.

Definition of metamorphism. Factors controlling metamorphism, Types of metamorphism.

Unit 2

Chemographic projections, concept of compatible and incompatible assemblages and discontinuous reactions, bulk composition influence on metamorphic assemblages

Structure and textures of metamorphic rocks, Relationship between metamorphism and deformation

Unit 3

Metamorphic zones and isograde s.

Metamorphic mineral reactions (prograde and retrograde)- exchange vectors and continuous reactions, Metamorphism series- Low P, Intermediate P and high P serieses

Unit 4

Concept of metamorphic facies and grade, Migmatites and their origin

Metasomatism and role of fluids in metamorphism , basics of geothermobarometry.

Unit 5

Metamorphic rock associations-schists,gneisses,khondalites,charnockites,blueschists and eclogites, tectonic setting of metamorphic rocks, paired metamorphic belts.

Practical

Megascopic and microscopic study (textural and mineralogical) of the following metamorphic rocks:

Low grade metamorphic rocks:serpentinites,albite-epidote-chloritequartzschist,slate,ta1c-tremolite- ca1cite-quartzschist.

Medium to high grade metamorphic rocks: Gneisses, amphibolite, hornfels, garnetiferous schists,

sillimanite-kyanite-bearingrocks, Granulites, eclogite,diopside-forsterite marble. Laboratory exercises in graphic plots for petrochemistry and interpretation of assemblages.

Mineral formula calculations.

References

1. Philpotts, A., & Ague, J.(2009).*Principles of igneous and metamorphic petrology*.Cambridge

University Press.

2. Winter, J. D.(2014).*Principles of igneous and metamorphic petrology*.Pearson.

3. Raymond,L.A.(2002).*Petrology:thestudyofigneous,sedimentary,andmetamorphicrocks*.

McGraw-Hill Science Engineering.

4. Yardley, B. W., & Yardley, B. W. D. (1989). An introduction to metamorphic petrology.

Longman Earth Science Series.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Mineral assemblages, facies, phase rule, continuous and discontinuous reactions, metamorphic facies

Mineral Science
(GEOL CC2)
Core Course - (CC) Credit:6

Course Objective(2-3)

To develop an understanding of minerals as pure and impure phases

Minerals as the building block of earth and planetary mass
Basic understanding of crystallography and crystal chemistry

Course Learning Outcomes

1) Identify common rock-forming minerals in hand specimen and in thin section using diagnostic physical, optical, and chemical properties

(2) learning about crystallography and to infer the environment of formation of minerals

(3) minerals as a tool to understand Earth processes, Earth's Interior and Earth history

Unit 1

Rock forming minerals

Minerals-definition and classification, physical and chemical properties

Unit 2

Crystal symmetry

Elements of crystal chemistry and aspects of crystal structures

Silicate and non-silicate structures; CCP and HCP structures

Composition of common rock-forming minerals

Unit 3

Crystallography

Elementary ideas about crystal morphology in relation to internal structures

Crystal parameters and indices

Crystal symmetry and classification of crystals in to six systems and 32 point groups

Stereographic projections of symmetry elements and forms

Unit 4

Properties of light and optical microscopy

Nature of light and principles of optical mineralogy

Introduction to the petrological microscope and identification of common rock-forming minerals

Practical

Study of physical properties of minerals in hand specimen

Silicates: Olivine, Garnet, Kyanite, Staurolite, Tourmaline, Serpentine, Talc, Muscovite, Biotite, Quartz,Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite.

Quartz varieties: Chert, Flint, Chalcedony, Agate, Jasper, Amethyst, Rosequartz, Smoky quartz, Rock crystal.

Native Metals/non-metals, Sulfides, Oxides-Copper, Sulfur, Graphite, Pyrite, Corundum, Magnetite

Hydroxides, Halides, Carbonates, Sulfates, Phosphates: Psilomelane, Fluorite, Calcite, Malachite, Gypsum, Apatite.

Study of some key silicate minerals under optical microscope and their characteristic properties

References

1. Putnis A. Introduction to mineral Sciences, Cambridge publication, 1992

2. Cornelis Klein and Barbara Dutrow, The manual of Mineral Science, Wiley Publication 2007

3. Kerr P. F. Optical Mineralogy, 1959. McGraw-Hill.

4. Verma P. K., Optical mineralogy, CRC press 2009

5. Nesse W. D., Introduction to Optical mineralogy.2008, Oxford University Press.

6. Deer W. A., Howie.R. A. and Zussman, J., An introduction to the rock forming minerals 1992

1. Putnis A. Introduction to mineral Sciences, Cambridge publication, 1992

2. Cornelis Klein and Barbara Dutrow, The manual of Mineral Science, Wiley Publication 2007

3. Kerr P. F. Optical Mineralogy, 1959. McGraw-Hill.

4. Verma P. K., Optical mineralogy, CRC press 2009

5. Nesse W. D., Introduction to Optical mineralogy.2008, Oxford University Press.

6. Deer W. A., Howie.R. A. and Zussman, J., An introduction to the rock forming minerals 1992

Additional Resources:

Additional Resources:

Dana's Manual of Mineralogy

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments

Assessment Methods

Tests, Quiz, Debates and Presentations

Keywords

Pure and impure phases, crystals, lattice, silicates, coordination number

Paleontology
(GEOL CC9)
Core Course - (CC) Credit:6

Course Objective(2-3)

Palaeontology is the branch of science that deals with the study of remains of animals and plants (fossils) of the geological past preserved in the rocks. Fossils offer the best evidence for the evolution of life on the Earth and ho life forms had responded to climatic and environmental changes. The students will learn to appreciate this significance upon completion of the course.

Course Learning Outcomes

On successful completion of the course, the student will be able to:

- Appreciate how fossils get preserved in rocks, the nature of fossil record and how fossils are named in a taxonomic framework

- Get to know different invertebrate fossil groups, their palaeobiology, and how they can be used in relative dating of rocks.

- Learn how vertebrates originated and their evolution through time.

- Understand important floral changes over time and the flora of the Indian coal-bearing sedimentary basins.

- Analyse the indirect evidences preserved in the rocks for the past existence of life.

- Critically analyse the role of fossils in relative dating of rocks, in interpreting past environments, past distribution of land and sea, and changes in ecosystems over time.

Unit 1

Fossilization and fossil record

Fossilization processes and modes of preservation; nature and importance of fossil record

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Unit 2

Taxonomy and Species concept

Species concept with special reference to palaeontology, taxonomic hierarchy, Theory of organic evolution interpreted from fossil record.

Unit 3

Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significance

Significance of ammonites in Mesozoic biostratigraphy and their paleobiogeographic implications

Functional adaptation intrilobites and ammonoids.

Unit 4

Vertebrates

Origin of vertebrates and major steps in vertebrate evolution

Vertebrate evolution in the Palaeozoic Era

Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs

Evolution of horse and intercontinental migrations. Human evolution.

Unit 5

Introduction to Palaeobotany; fossil record of plants through time; Gondwana Flora

Unit 6

Introduction to Ichnology; utility of ichnofossils in interpreting sedimentary environments.

Application of fossils in Stratigraphy

Biozones, index fossils, correlation

Role of fossils in sequences tratigraphy

Fossils and paleoenvironmental analysis

Fossils and paleobiogeography, biogeographic provinces, dispersals and barriers

Paleoecology– fossils as a window to the evolution of ecosystems

Practical

Study of fossils showing various modes of preservation

Study of diagnostic morphological characters, systematic position, stratigraphic position and age of various invertebrate, vertebrate and plant fossils.

References

1. Raup, D. M.,Stanley, S.M., Freeman,W. H.(1971)Principles of Paleontology
2. Clarkson, E. N.K.(2012)Invertebrate Paleontology and evolution 4th Edition byBlackwell Publishing.
3. Benton,M. (2014). Vertebrate Palaeontology., fourth edition
4. Shukla, A. C., &Misra, S.P. (1982).Essentials of paleobotany.
5. Stewart, W.N. & Rothwell, G.W. (2018). Paleobotany and the Evolution of Plants
5. Armstrong, H.A., & Brasier, M.D.(2005)Microfossils. Blackwell Publishing.
6. Jones, R.W. (2011). Applications of Palaeontology - Techniques and Case Studies
7. Briggs, D.E.G. & Crowther, P.R. (2003). Palaeobiology II.
8. Foote, M. & Miller, A. I. (2006). Principles of Paleontology, third edition.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Fossils, vertebrates, invertebrates, paleobotany, paleobiology

Remote sensing and GIS
(GEOL CC12)
Core Course - (CC) Credit:6

Course Objective(2-3)

The main aim of this course is to 1) learn about the fundamentals of remote sensing, photogeology, GIS, and GPS 2) learn basics remote sensing and GIS techniques, and 3) learn uses of remote sensing and GIS in different field

Course Learning Outcomes

In this course a student will learn about 1) the basic concepts of remote sensing, 2) Basic concepts of Photogeology and Photogrammetry, 3) the basic concepts of GIS, 4) GIS softwares viz., QGIS, Basicconcepts and functioning of Global Positioning System (GPS).

Unit 1

Photogeology

Types and acquisition of aerial photographs; Scale and resolution; Principles of stereoscopy, relief displacement, vertical exaggeration and distortion, Elements of air photo interpretation, Identification of sedimentary, igneous and metamorphic rocks.

Unit 2

Remote Sensing

History of Remote Sensing and Indian Space Program, Basic concepts of Remote Sensing, Satellites and their characteristics, Data formats- Raster and Vector

Unit 3

Digital Image Processing

Various processes of Digital Image Processing - Preprocessing, Image Enhancement, Transformation. Filtering, Image Rationing, Image classification, and accuracy assessment (Errors calculation).

Unit 4

GIS

Datum, Coordinate systems and Projection systems, Spatial data models and data editing, Introduction to DEM analysis, GIS integration and Case studies-Indian Examples

Unit 5

GPS

Basic concepts of GPS, Integrating GPS data with GIS Applications in earth system sciences

Practical

- Aerial Photo interpretation, identification landforms
- Digital Image Processing exercises including analysis of satellite data in different bands and interpretation of various objects on the basis of their spectral signatures.
- Creating a FCC from raw data
- Geo-referencing of satellite data with a toposheet of the area
- Introduction to QGIS software
- DEM analysis: generating slope map, aspect map and drainage network map

References

- **Text Book -** Remote Sensing and GIS by Basudeb Bhatta, Oxford Publications
- Remote Sensing and Image Interpretation by Lillesand, Kiefer and Chipman, Wiley Publications
- Geographic Information System and Science by PA Longley, MF Goodchild, DJ Maguire and DW Rhind, Wiley Publications
- Fundamentals of Geographic Information Systems by MN Demers, Wiley Publications.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

GIS, GPS, Photogeology, Digital Image Processing, DEM

Sedimentary Petrology
(GEOL CC3)
Core Course - (CC) Credit:6

Course Objective(2-3)

To develop an understanding of s near-surface processes of the planet 'Earth

Learning to decode signatures of exogenic processes including climate and tectonics.

Course Learning Outcomes

Sedimentary rocks host all fossil fuels (coal, oil and gas), which is the driving force of modern civilization. Understanding basic processes of sedimentation (physical and chemical) including behavior of fluids, fluid-grain interaction, structures formed thereof and processes control chemical sedimentation viz. carbonates, BIF, Phosphorite etc. is the goal of this course. The course will also aim for exposing students to different kinds of sedimentary rocks, their structures, textures and variability. Attempt will be made to provide students a holistic understanding of sedimentation process from deposition to diagenesis.

Unit 1

Origin of sediments

Weathering and sedimentary flux: Physical and chemical weathering, Role of climate and Tectonics. Soils and Paleosols.

Unit 2

Sediment granulometry

Grain size scales Udden-Wentworth and Krumbein (phi) scale, particle size distribution; mean, median, mode. Environmental connotation; particle shape and fabric (Grain roundness and Sphericity)

Unit 3

Sedimentary textures, structures and environment

Fluid flow, sediment transport and sedimentary structures: Types of fluids, Laminar vs. turbulent flow, Particle entrainment, transport (bedload, saltation and suspension) and deposition. Inter- and Intra-bed sedimentary structures, Penecontemporaneous Deformation Structures (PCD) and Trace fossils.

Paleocurrent analysis-Scalar and Vector attributes; Paleocurrents for different sedimentary environments

Unit 4

Varieties of sedimentary rocks

Siliciclastic rocks: Conglomerates, sandstones, mudrocks.

Carbonate rocks, controls of carbonate deposition, components and classification of limestone, dolomite and dolomitisation

Unit 5

Diagenesis

Concepts of diagenesis, Concept of pressure and thermal gradient,

Stages of diagenesis, Compaction and cementation. Siliciclastic and carbonate

Practical

Exercises on sedimentary structures

Particle size distribution and statistical treatment

Paleocurrent analysis

Petrography of selected clastic and non-clastic rocks through hand specimens and thin sections

References

1. Prothero, D. R.,& Schwab, F. (2004).Sedimentary geology. Macmillan.
2. Tucker, M. E. (2006) Sedimentary Petrology, Blackwell Publishing.
3. Collinson, J. D. &Thompson, D. B. (1988) Sedimentary structures, Unwin-Hyman, London.
4. Nichols,G. (2009) Sedimentology and Stratigraphy Second Edition. Wiley Blackwell
5. Lewis, D.W. and McConchie, D., (1984) Practical sedimentology Wiley Blackwell

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments

Assessment Methods

Tests, Quiz, Debates and Presentations

Keywords

Near surface process, sedimentation, clastic,non-clastic, environment, structure, facies

Stratigraphic Principles and Indian Stratigraphy
(GEOL CC7)
Core Course - (CC) Credit:6

Course Objective(2-3)

The stratigraphy provides basic understanding of rock superposition through time and their relative age. The concept provides the paleogeographic shift (distribution of land and sea) at broader scale and incremental shift of environment, energy conditions, tectonics, climate etc. at finer scale within basin or formation level. The basic understanding of this will be achieved by the student from this course.

Course Learning Outcomes

Comprehensive understanding of fundamentals of stratigraphic principles and various methods of stratigraphic analysis will be provided. The stratigraphic classification from craton, mobile belt, Proterozoic to Phanerozoic succession from India is the goal of this course. Time concept in stratigraphic and major stratigraphic boundaries and their causative factors will be discussed in detail. Geological factors controlling the hydrocarbon accumulation and their future prospective will be discussed.

Unit 1

Principle of stratigraphy

Definition and scope of stratigraphy, principle of superposition, original horizontality and uniformitarianism. Fundamentals of litho-, bio- and chrono-stratigraphy. Facies concept in stratigraphy, Walther's Law of facies succession. Concept of paleogeographic reconstruction. Introduction to concepts of dynamic stratigraphy (chemostratigraphy, seismic stratigraphy, sequence stratigraphy, magnetostratigraphy and their subdivisions with Indian examples.

Unit 2

Code of stratigraphic nomenclature

International Stratigraphic Code – development of a standardized stratigraphic nomenclature, Concept of Stratotypes. Global Stratotype Section and Point (GSSP).

Unit 3

Precambrian Stratigraphy

Brief introduction to the physiographic and tectonic subdivisions of India. Introduction to Indian Shield (ctraton and mobile belts of India). Introduction to Proterozoic sedimentary basins of India. Geology of Vindhyan and Cudappah basins.

Unit 4

Phanerozoic Stratigraphy

Paleozoic stratigraphy of India:

Paleozoic Succession of Kashmir and its correlatives from Spiti and Zanskar Stratigraphy. Geology and hydrocarbon potential of Gondwana basins.

Mesozoic stratigraphy of India:

a. Triassic successions of Spiti, b. Jurassic of Kutch, c. Cretaceous successions of Cauvery

Cenozoic stratigraphy of India:

a. Kutch basin, b. Siwalik successions, c. Assam, Andaman and Arakan basins

Stratigraphy and structure of Krishna-Godavari basin, Cauvery basin, Bombay offshore basin, Kutch and Saurashtra basins and their potential for hydrocarbon.

Unit 5

Volcanic provinces of India

a. Deccan,

b. Rajmahal,

c. Sylhet Trap

Unit 6

Major stratigraphic boundaries

a. Precambrian-Cambrian boundary, b. Permian-Triassic boundary, and c. Cretaceous-Palaeogene boundary

Practical

1. Study of geological map of India and identification of major stratigraphic units.

2. Study of rocks in hand specimens from known Indian stratigraphic horizons
3. Drawing various paleogeographic maps.
4. Study of different Proterozoic supercontinent reconstructions.
5. Interpretation of various stratigraphic logs and their correlation.

References

1. Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
2. Doyle, P. & Bennett, M. R. (1996) Unlocking the Stratigraphic Record. John Wiley
3. Ramakrishnan, M. &Vaidyanadhan, R. (2008) Geology of India Volumes 1 & 2, Geological society of India, Bangalore.
4. Valdiya, K. S. (2010) The making of India, Macmillan India Pvt. Ltd.
5. Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Code of stratigraphic nomenclature, order of superposition, chronostratigraphy, lithostratigraphy, biostratigraphy

Structural Geology
(GEOL CC4)
Core Course - (CC) Credit:6

Course Objective(2-3)

To have an understnding of the geometry of deformation of earth material

To identify these features in natural occurence
To measure attributes of such features and to relate these to regkional deformational context

Course Learning Outcomes

Structural geology essentially deals with the geometry, kinematics and dynamics of deformation of rocks. In response to the instability of the lithosphere produced by complex plate tectonic movements, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales and at different depths, which manifests in a variety of complex structures in these rocks. The undergraduate CBCS course of structural geology will teach the students the different geometric features of deformation, different types of deformation-induced structures, basic techniques of measurement of different parameters in deformed rocks, and will also give them a glimpse of the underlying deformation processes and mechanisms.

Unit 1

Introduction to Structure and Topography

Understanding a topographic map; Effects of topography on structural features: Rule of V; Planar and linear structures; Concept of dip and strike, trend and plunge.

Unit 2

Stress and strain in rocks

Concept of rock deformation: Definition of Stress and Strain, Stress tensor in 3D; Strain ellipses of different types and their geological significance.

Unit 3

Folds

Fold morphology; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding; Outcrop patterns of different fold structures.

Unit 4

Foliation and lineation

Description and origin of foliations: axial plane cleavage and its tectonic significance; different types of foliations: crenulation cleavage, disjunctive cleavage, slaty cleavage, schistosity, gneissosity etc.

Description and origin of lineation and relationship with major structures; stretching lineation and its relationship with strain.

Unit 5

Fractures and faults

Geometric and genetic classification of fractures and faults; Effects of faulting on the outcrops; Geologic/geomorphic criteria for recognition of faults and fault plane solutions.

Joints – different types of joints and their geological significance – columnar joint, pinnate joint, plumose structure.

Practical

· Basic idea of topographic contours, Topographic sheets of various scales.

· Structural contouring and 3-point problems of dip and strike

· Introduction to Geological maps: Drawing profile sections and interpretation of geological maps of different complexities

· Exercises of stereographic projections of mesoscopic structural data (planar, linear, folded etc.)

References

1. Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley
2. Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall.
3. Park, R. G. (2004) Foundations of Structural Geology.Chapman & Hall.
4. Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.
5. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practical)
6. Lahee F. H. (1962) Field Geology. McGraw

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments

Assessment Methods

Tests, Quiz, Debates and Presentations

Keywords

Fole, fault, lineations, cleavage, stress, strain, orogeny

EARTH AND CLIMATE
(GEOLDSE2)
Discipline Specific Elective - (DSE) Credit:6

Unit 1

Climate system: Forcing and Responses

Components of the climate system

Climate forcing, Climate controlling factors

Climate system response, response rates and interactions within the climate system

Feedbacks in climatesystem

Unit 2

Heat budget of Earth

Incoming solar radiation, receipt and storage of heat

Heat transformation

Earth’s heat budget. Interactions amongst various sources of earth’s heat

Unit 3

Atmosphere - Hydrosphere

Layering of atmosphere and atmospheric Circulation Atmosphere and ocean interaction and its effect on climate Heat transfer in ocean

Global oceanic conveyor belt and its control on earth’s climate

Surface and deep circulation

Sea ice and glacial ice

Unit 4

Response of biosphere to Earth’s climate Climate Change: natural vs. anthropogenic effects Humans and climate change

Future perspectives

Brief introduction to archives of climate change

Archive based climate change data from the Indian continent

Unit 5

Orbital cyclicity and climate

Milankovitch cycles and variability in the climate

Glacial-interglacial stages

The Last Glacial maximum (LGM) Pleistocene Glacial-Interglacial cycles Younger Dryas

Marine isotope stages

Unit 6

Monsoon Mechanism of monsoon Monsoonal variation through time

Factors associated with monsoonal intensity

Effectsofmonsoon

Practical

1. Study of distribution of major climatic regimes of India on map

2. Distribution of major wind patterns on World map

3. Preparation of paleogeographic maps (distribution of land and sea) of India during specific geological time intervals

4. Numerical exercises on interpretation of proxy records for paleoclimate

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References

1. Rudiman, W.F., 2001. Earth's climate: past and future. Edition 2, Freeman Publisher.

2. Rohli, R.V., and Vega, A.J., 2007. Climatology. Jones and Barlatt

3. Lutgens, F., Tarbuck, E., and Tasa, D., 2009. The Atmosphere: An Introduction to Meteorology.

Pearson Publisher

4. Aguado, E., and Burt, J., 2009. Understanding weather

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Orbital cyclicity, monsoon, LGM, hydrosphere, biosphere, lithosphere, cryopshere

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Evolution of life through time
(GEOLDSE 5)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To know the evolution of life through geological time

To understand the role of geological processes in the evolution of life

To learn about major biological events of the geological past

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Course Learning Outcomes

Will be able to understand how life originated and evolved through time.

Gives an idea about how fossilisation processes operate in nature.

How organisms had responded to changes in environment and climate in the geological past.

Will learn about major mass extinction events in the Phanerozoic history of life

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Unit 1

Life through ages

Fossils and chemical remains of ancient life.

Geological Time Scale with emphasis on major bio-events. Fossilization processes and modes of fossil preservation.

Exceptional preservation sites- age and fauna

Unit 2

Geobiology

Biosphere as a system, processes and products

Biogeochemical cycles

Abundance and diversity of microbes, extremophiles

Microbes-mineralinteractions, microbialmats

Unit 3

Origin of life,

Possible life sustaining sites in the solar system, life sustaining elements and isotope records

Archean life: Earth’s oldest life, Transition from Archean to Proterozoic, the oxygen revolution and radiation of life

Precambrian macrofossils – The garden of Ediacara

The Snow Ball Earth Hypothesis

Unit 4

Paleozoic Life

The Cambrian Explosion. Biomineralization and skeletalization

Origin of vertebrates and radiation of fishes

Origin of tetrapods - Life out of water

Early land plants and impact of land vegetation

Unit 5

Mesozoic Life

Life after the largest (P/T) mass extinction, life in the Jurassic seas

Origin of mammals

Rise and fall of dinosaurs

Origin of birds; and spread of flowering plants

Unit 6

Cenozoic Life

Aftermath of end Cretaceous mass extinction – radiation of placental mammals

Evolution of modern grasslands and co-evolution of hoofed grazers

Rise of modern plants and vegetation

Back to water – Evolution of Whales

The age of humans

Hominid dispersals and climate setting

Practical

1. Study of modes of fossil preservation

2. Study of fossils from different stratigraphic levels

3.Exercises related to major evolutionary trends in important groups of animals and plants

References

1. Stanley, S.M., 2008 Earth System History

2. Jonathan I. Lumine W.H.Freeman Earth-Evolution of a Habitable World, Cambridge University Press.

3. Canfield, D.E. & Konhauser, K.O., 2012 Fundamentals of Geobiology Blackwell

4. Cowen, R., 2000 History of Life, Blackwell

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

GOE, Ediacaran fauna, Snow Ball Earth, Cambrian Explosion of life, Mass Extinctions

EXPLORATION GEOLOGY
(GEOLDSC1)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

Exploration geology is concerned with the location of ore and other materials found within the earth. Their work is essential to energy and production industries as it acts as a starting point for extraction.

Course Learning Outcomes

1. Understanding of industrial and non-industrial resources and distinction between reserve and resource
2. Natural resource consumption patterns through historical times
3. Principles of prospecting of exploration
3. Techniques of mineral exploration
4. Reserve estimation methods

Unit 1

Mineral Resources

Resource reserve definitions, Industrial and non-industrial economic minerals, Mineral resources in industries – historical perspective and present, A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies.

Unit 2

Prospecting and Exploration,

Principles of mineral exploration, Prospecting and exploration- conceptualization, methodology and stages, Sampling, subsurface sampling including pitting, trenching and drilling, Geochemical exploration.

Unit 3

Geophysical methods of exploration

Evaluation of data

Evaluation of sampling data

Mean, mode, median, standard deviation and variance

Unit 4

Drilling and Logging

Core and non-core drilling. Basic parts of a drilling machnie

Planning of bore holes and location of boreholes on ground

Core-logging

Unit 5

Reserve estimations and Errors

Density and bulk density

Principles of reserve estimation, Critical Geological data to be considered

Factors affecting reliability of reserve estimation

Reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks) Regular and irregular grid patterns, statistics and error estimation

Practical

1. Identification of anomaly
2. Concept of weighted average in anomaly detection
3. Geological cross-section
4. Models of reserve estimation

References

1. Clark, G.B. 1967. Elements of Mining. 3rd Ed. John Wiley & Sons.

2. Arogyaswami, R.P.N. 1996 Courses in Mining Geology. 4th Ed. Oxford-IBH.

3. Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Reserve, resource, drilling, reserve estimation, exploration

FUEL GEOLOGY
(GEOLDSE3)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

There is no doubt that petroleum use and exploration of oil is one of the most powerful driving forces in shaping c modern world. Petroleum Geologists are the men and women who know how to understand the earth beneath ou feet in order to find oil and natural gas, which are vital resources in our lives. Our r country is big importer of fuel and needs a balanced attention towards this course.

Course Learning Outcomes

1. Types of conventional and non-conventional fuels and consumption trends through time

2. Coal- origin, types and resources

3. Petroleum- origin, traps, occurence in specific geological domains

4. Non-conventional hydrocarbons

5. Nuclear fuels

Unit 1

Coal

Definition and origin of Coal

Basic classification of coal

Fundamentals of Coal Petrology - Introduction to lithotypes, microlithotypes and macerals in coal

Proximateand Ultimateanalysis

Unit 2

Coal as a fuel

Coal Bed Methane (CBM): global and Indian scenario

Underground coal gasification

Coalliquefaction

Unit 3

Petroleum

Chemical composition and physical properties of crudes in nature

Origin of petroleum

Maturation ofkerogen;Biogenic andThermaleffect

Unit 4

Petroleum Reservoirs and Traps

Reservoir rocks: general attributes and petrophysical properties. Classification of reservoir rocks - clastic and chemical. Hydrocarbon traps: definition, anticlinal theory and trap theory

Classification of hydrocarbon traps - structural, stratigraphic and combination

Time of trap formation and time of hydrocarbon accumulation. Cap rocks - definition and general properties.

Plate tectonicsand globaldistribution ofhydrocarbon reserv

Unit 5

Otherfuels

Gas Hydrate

Nuclear Fue

Practical

1. Study of hand specimens of coal
2. Reserve estimation of coal
3. Section correlation and identification of hydrocarbon prospect
4. Panel and Fence diagrams

References

1. Chandra D. (2007). Chandra's Textbook on applied coal petrology. Jijnasa Publishing House.
2. Shelly R. C. (2014). Elements of Petroleum geology: Third Edition, Academic Press
3. Bjorlykke, K. (1989). Sedimentology and petroleum geology. Springer-Verlag.
4. Bastia, R., & Radhakrishna, M. (2012). Basin evolution and petroleum prospectivity of the continental margins of India (Vol. 59). Newnes.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Natural energy sources, coal, petroleum, traps, nuclear fuel

Introduction to Geophysics
(GEOLDSE 7)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To develop an understanding of solid earth and interior of earth and to learn about the basic geophysical explorati techniques.

Course Learning Outcomes

1. Physical properties of the natural material
2. Earth's interior through indirect methods
3. Geophysical exploration methods

Unit 1

Geology and Geophysics

Interrelationship between geology and geophysics, Role of geological and geophysical data in explaining geodynamical features of the earth.

Unit 2

General and Exploration geophysics

Different types of geophysical methods - gravity, magnetic, electrical and seismic; their principles and applications

Concepts and Usage of corrections in geophysical data

Unit 3

Geophysical field operations

Different types of surveys, grid and route surveys, profiling and sounding techniques

Scales ofsurvey, Presentation ofgeophysicaldata

Unit 4

Application of Geophysical methods

Regional geophysics, oil and gas geophysics, ore geophysics, groundwater geophysics, engineering geophysics

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Unit 5

Geophysical anomalies

Correction to measured quantities, geophysical, anomaly, regional and residual (local) anomalies, factors controlling anomaly, and depth of exploration

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Unit 6

Integrated geophysical methods

Ambiguities in geophysicalinterpretation,planningand execution ofgeophysicalsurveys

Practical

Anomaly and background- Graphical method

Study and interpretation of seismic reflector geometry

Problems on gravity anomaly

References

1. Outlines of Geophysical Prospecting - A manual for geologists by Ramachandra Rao, M.B., Prasaranga, University of Mysore, Mysore, 1975.
2. Exploration Geophysics - An Outline by Bhimasarikaram V.L.S., Association of Exploration Geophysicists, Osmania University, Hyderabad, 1990.
3. Dobrin, M.B. (1984) An introduction to Geophysical Prospecting. McGraw-Hill, New Delhi.
4. Telford, W. M., Geldart, L. P., & Sheriff, R. E. (1990). *Applied geophysics* (Vol. 1). Cambridge university press.
5. Lowrie, W. (2007). Fundamentals of geophysics. Cambridge University Press.

Teaching Learning Process

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

physical properties, solid earth, density, passive and active sources, geophysical logging

River Science
(GEOLDSE 6)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To understand the life cycle of a river especially in relation to societal development. To understand the process of erosion and transportation of sediments and its connection with the landforms

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Course Learning Outcomes

1. Rivers through geological time
2. Fluvial degradational and aggradational processes
3. Landforms associated with the rivers

Unit 1

Stream hydrology

Basic stream hydrology

Physical properties of water, sediment and channel flow

River discharge, River hydrographs (UH, IUH, SUH, GIUH) and its application in hydrological analysis

Flood frequency analysis

Unit 2

River basin

Sediment source and catchment erosion processes

Sediment load and sediment yield

Sediment transport processes in rivers

Erosion and sedimentation processes in channel.

Unit 3

Drainage

Drainage network

Quantitative analysis of network organization - morphometry

Random Topology (RT) model and fractal analysis

Role of drainage network in flux transfer

Evolution of drainage network in geological time scale.

Unit 4

Rivers in time and space

River diversity in space, Patterns of alluvial rivers - braided, meandering and anabranching channels, Dynamics of alluvial rivers

Channel patterns in stratigraphic sequences

Different classification approaches in fluvial geomorphology and its applications.

Unit 5

Channels and Landscapes

Bedrock channels, Bedrock incision process

River response to climate, tectonics and human disturbance

Bedrock channel processes and evolution of fluvial landscapes.

Unit 6

Fluvial hazards

Integrated approach to stream management

Introduction to river ecology.

Practical

Stream power calculation

Longitudinal profile analysis

Hydrograph analysis and other related problems

References

1. Davies, T. (2008) Fundamentals of hydrology. Routledge Publications.

2. Knighton, D. (1998) Fluvial forms and processes: A new perspective. Amold Pubs.

3. Richards. K. (2004) Rivers: Forms and processes in alluvial channels. Balckburn Press.

4. Bryirely and Fryirs (2005) Geomorphology and river management. Blackwell Pub.,

5. Julien, P.Y. (2002) River Mechanics. Cambridge University Press.

6. Robert, A. (2003) River Processes: An introduction to fluvial dynamics. Arnold Publications.

7. Vanoni, V.A. (2006) Sedimentation Engineering. ASCE Manual, Published y American Society of

Civil Engineering,

8. Tinkler, K.J., Wohl, E.E. (eds.) 1998. Rivers over rock. American Geophyscial UnionMonogrpah, Washington, DC.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

hydrology, stream power, river basin, fluvial hazards, aggradation, erosion

URBAN GEOLOGY
(GEOLDSE4)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

It is an emerging discipline in an increasingly urbanized world, particularly fast developing nation like India. In th broadest terms, urban geology is the application of the earth sciences to problems arising at the nexus of the geosphere, hydrosphere and biosphere within urban and urbanizing areas.

Course Learning Outcomes

Urban geology draws on the all branches of the earth sciences, from stratigraphy to geochemistry and hydrogeology to geophysical exploration techniques; and it often makes linkages to the biological and environmental sciences.

1. Linking geology to the infrastructure developments

2. Linking geology to upkeep and optimization of natural resources like water and soil

3. Identifying possible domains of natural hazard in the context of town planning

Unit 1

Geology and Society Necessity of Geology in Urban life. Geology in Urban Constructions

Geotechnical feature and mapping for subsurface in Metropolitan areas

Building materials, Excavation and cutting in urban areas.

Unit 2

Geology and Urban Agriculture

Soil studies, Chemistry and geochemistry of soil in relation to ground water and fertilizer

Effect of pollutants on vegetable contamination

Unit 3

Urban land use

Geotechnical site characterization, Geotechnical and land use mapping, Decision making in urban landuse, Geological problems in construction of underground structures in urban areas

Urban Tunneling: Tunneling for road and rail in urban areas, Method, Equipments, Importance of

Geology

Unit 4

Urban water

Water lagging in built-up areas, Source of water, Standards for various uses of water

Sources of contamination

Waste waters: Sources and its disinfection and treatment, Ground water surveys and resource development.

Unit 5

Urban wastesandTreatment, Geotechnicalcharacterization forwastesites, Domestic waste, Industrialwaste,Mine drainage, Powerproduction waste, Radioactive waste, Need forspecial purpose mappingforselection ofwastedisposalsites.

Unit 6

GIS in Urban Geology

GIS-An introduction, Application in Urban development, Application in landuse, Application in GW Exploration.

Precaution from seismic hazard in Urban planning

Seismic Hazards: Micro-zonations of hazard based on engineering geological features, Urban- subservice network.

Practical

1. Map Reading

2. Ground water flow direction estimation

3. Case studies of Urban flood; Flood hydrographs

4. Case studies of urban planning

References

1. Huggenberger, P. and Eptin, J. 2011 Urban Geology: Process-Oriented Concepts for Adaptive and Integrated Resource Management. Springer

2. Lollino, G. et al. (Ed.), Engineering Geology for Society and Territory. Springer

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Urban planning, GIS, natural hazard, pollution, engineering geology, earthquake

Basic Field Training
(GEOLSE 1)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

Introduce students to the natural occurrence of rocks and minerals

Course Learning Outcomes

1. teaching attitudes of linear and planar structures
2. Introduction to front and back bearing and marking location on map
3. Map reading

Unit 1

Identification of rocks and minerals

Unit 2

OrientationofTopographicsheetin field, markinglocation intoposheet, Bearing(Frontand back). Conceptsofmap reading, Distance, heightandpace approximation

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Unit 3

Identification of rocktypes in field;structures and texture of rocks, Use ofhand lens

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Unit 4

Basicfield measurement techniques:Beddingdip and strike, Lithologmeasurement Readingcontours and topography

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Teaching Learning Process

Demonstration and measurement

Assessment Methods

Field report and viva voce

Keywords

clinometer, brunton compass, hand lens, toposheet, thematic maps

Economic Geology field
(GEOLSE 3)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To introduce and acquaint the student to the natural occurrences of economic mineral deposits linking theory of mineral deposit formation to field-based interpretations

Course Learning Outcomes

1. Demonstration of field occurrence of mineral deposits- overground as well as underground
2. Identification and recording of evidence of mineralization such as alteration zones etc.
3. Learning the role of geology in mining of the mineral deposits

Unit 1

Visit to mineral deposits (one metallic and one industrial mineral deposit) and study of ore mineralogy as well as relation with the host.

Unit 2

Ore formation process,

Basictechniquesofsurveying, conceptofoutcrop map

Unit 3

Visit tounderground oropen castmine

Practical experience of mining methods

Unit 4

Underground mapping/Bench mapping

Isopach and Isochore maps

Teaching Learning Process

Demonstration and measurements

Assessment Methods

Field report and viva voce

Keywords

mineral deposit, ore, gangue, mine, exploration, beneficiation, smelting

Geological Mapping
(GEOLSE 2)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

Preparing thematic mappers

Course Learning Outcomes

1. Accurate location matching on ground and map
2. Accurate measurements of geological features
3. Preparation of thematic maps

Unit 1

Geologicalmapping, stratigraphiccorrelation

Unit 2

Primary(scalars and vectors)and secondarystructures (linearandplanar)

Unit 3

Trend, plunge, Rake/Pitch

Unit 4

Stereoplots of linear and planar structures, Orientation analyses

Teaching Learning Process

Demonstration and measurements

Assessment Methods

Report and viva voce

Keywords

fold axis, azimuth, plunge, axial plane cleavage, throw, hade

Himalayan Geology field
(GEOLSE 4)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To observe, identify and map the lithologic, structural and geomorphic elements of an evolving ororgen

Course Learning Outcomes

1. To recognize imprints of major tectonic processes in orogens

2. To relate the structural and lithological elements to the structural level of an orogenic mountain

3. To identify longitudinal boundaries of the Himalayas and to distinguish the transverse elements

Unit 1

Identification and characterization of major structural boundaries in Himalaya viz. MBT, MFT etc. or

Unit 2

Field alonganysuitable transectofHimalayan foreland

Unit 3

Field transect in Siwalik

Unit 4

Identification of Himalayan and pre-Himalayan elements

Teaching Learning Process

Demonstration and measurements

Assessment Methods

Field report and viva voce

Keywords

Orogen, Lesser Himalayas, Higher Himalayas, Central crystallines, Trans-Himalayas, thrust, Tertiary metamorphis and magmatism

Precambrian Geology field
(GEOLSE 5)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

The aim of the course is to acquaint students to the craton, mobile belts and within craton sedimentary basins of the shield areas.

Course Learning Outcomes

1. To distinguish elements of mobile belts or older orogens in areas of low relief
2. To understand basic elements of a stabilized cratons
3. To understand role of extensional tectonics in such regions and
4. To observe features of intracratonic sedimentary basins

Unit 1

Field transect in any Precambrian terrain and mapping of structural patterns

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Unit 2

Study of craton ensemble including basic intrusive suites

Unit 3

Precambrian sedimentary basin

Unit 4

Basement-Cover relation in: a. fold belts, b. sedimentary successions

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Teaching Learning Process

Demonstration and measurements

Assessment Methods

Field report and viva voce

Keywords

Shield, craton, mobile belt, sedimentary basin, basement-cover relationship, extensional tectonics

Stratigraphy and Paleontology related field
(GEOLSE 7)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

Following the stratigraphic principles this field based skill enhancement course will train students in establishing succession of geological units and events observed in nature.

Course Learning Outcomes

1. Application of the Principle of Uniformitarianism in field
2. Basement cover relationships- identifications and interpretations
3. Establishing order of superposition of geological units especially with the help of biomarkers

Unit 1

Field training along Phanerozoic basin of India

Unit 2

Documentation of stratigraphic details in the field

Unit 3

Collection of sedimentological, stratigraphic and paleontological details and their representation

Unit 4

Facies concept and its spatio-temporal relation (Walther’s Law) and concept of facies distribution at

basinal-scale

Unit 5

Fossils sampling techniques and their descriptions

Teaching Learning Process

Demonstration and measurements

Assessment Methods

Field report and viva voce

Keywords

Order of superposition, sedimentation, fossils, biostratigraphy, Walther's law

Visit to Engineering project site
(GEOLSE 6)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To understand necessity of geological input in major engineering projects

Course Learning Outcomes

1. Site selection parameters for major infrastructure projects such as dams, tunnels, roads, railways and power projects

2. Fondation mapping

3. Reservoir mapping

4. Treatment methods for weak material

Unit 1

Geological mapping of a project site (Dam sites, Tunnel alignments etc)

Unit 2

On site visit&tostudy various geotechnicalaspects relatedtothe projectsite.

Unit 3

Identification ofgeotechnicalproblems ofaprojectsite andremedialmeasures tobetaken.

Unit 4

Identification ofenvironmentalproblems ofaprojectsiteandremedialmeasuresto be taken.

Unit 5

Computation ofrock mass Properties(RQD, RSR, RMR &Q) inthefield.

Unit 6

Identification of potential suspected/probable sites of Natural Disaster and suggestions about corrective/preventive measures.

Teaching Learning Process

Demonstration and measurements

Assessment Methods

Field report and viva voce

Keywords

Dams, tunnels, reservoir, grouting, large-scale mapping, RQR

EARTH RESOURCES AND ECONOMICS (GEOLGE4) Generic Elective - (GE) Credit:6

Course Objective(2-3)

To develop an understanding of earth's natural resources and its utilization as a global economic activity.

To understand the need and methods of conservation of finite natural resources

Course Learning Outcomes

1. Distinction between resource and reserves. Introduction to natural processes leading to earth resources

2. Energy- main conventional resources and their distribution

3. Energy- economic implications of asymmetric distribution of natural resources

4. Mineral conservation- principles and techniques

Unit 1

Earth Resources

Resource reserve definitions; mineral, energy and water resources in industries

Economic considerations

Historical perspective and present

A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies

Unit 2

Definition of Energy: Primary and Secondary Energy

Difference between Energy, Power and Electricity

Renewable and Non-Renewable Sources of Energy

The concept and significance of Renewability: Social, Economic, Political and Environmental Dimension of Energy

Development and energy consumption trends

Unit 3

Major Types and Sources of Energy

Resources of Natural Oil and Gas

Coal and Nuclear Minerals

Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy

Economics of conventional and non-conventional energy resources

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Unit 4

Energy Sources and Power Generation: Nuclear, Hydroelectric, Solar, Wind and Wave- General

Principles.

Ground water resources and its role in economic development of a country

Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells.

Unit 5

Global metal markets and projections

National mineral policy
Mineral conservation
UNFC classification
Legal, social and environmental aspects affecting the mine cycles

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Practical

1. Plotting of major Indian oil fields on map of India

2. Problems related to hydroelectric power generation

3. Problems related to assessment of possible oil exploration site from geological maps

4. Problems related to energy demand projection of India and possible mitigation pathways

5. Problems related to biofuel

References

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill

2. Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.

3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer

4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.

5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

6. An Introduction to Mineral Economics by K K Chatterjee, 2004, New Age Publishers

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Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Metals, LME, mine cycle, national mineral policy, UNFC, energy sources

Course Objective(2-3)

To develop an understanding of earth's natural resources and its utilization as a global economic activity.

To understand the need and methods of conservation of finite natural resources

Course Learning Outcomes

1. Distinction between resource and reserves. Introduction to natural processes leading to earth resources

2. Energy- main conventional resources and their distribution

3. Energy- economic implications of asymmetric distribution of natural resources

4. Mineral conservation- principles and techniques

Unit 1

Earth Resources

Resource reserve definitions; mineral, energy and water resources in industries

Economic considerations

Historical perspective and present

A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies

Unit 2

Definition of Energy: Primary and Secondary Energy

Difference between Energy, Power and Electricity

Renewable and Non-Renewable Sources of Energy

The concept and significance of Renewability: Social, Economic, Political and Environmental Dimension of Energy

Development and energy consumption trends

Unit 3

Major Types and Sources of Energy

Resources of Natural Oil and Gas

Coal and Nuclear Minerals

Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy

Economics of conventional and non-conventional energy resources

Unit 4

Energy Sources and Power Generation: Nuclear, Hydroelectric, Solar, Wind and Wave- General

Principles.

Ground water resources and its role in economic development of a country

Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells.

Unit 5

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National mineral policy
Mineral conservation
UNFC classification
Legal, social and environmental aspects affecting the mine cycles

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2. Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.

3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer

4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.

5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

6. An Introduction to Mineral Economics by K K Chatterjee, 2004, New Age Publishers

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Metals, LME, mine cycle, national mineral policy, UNFC, energy sources

EARTH SURFACE PROCESSES (GEOLGE6) Generic Elective - (GE) Credit:6

Course Objective(2-3)

The main aim of this course is to look in to the details of the processes shaping the surface of the earth. In this course, an understanding of the flow of energy through different geological domains would be provided. It will loo in to the details and techniques of the controls on the rates of various surface processes.

Course Learning Outcomes

n this course a student will develop holistic understanding of how earth surface processes work and interact with each other. They will learn about the tools and techniques to measure and interpret rates of earth surface processes. They will also learn the applied aspects of the earth surface processes investigation.

Unit 1

Introduction to earth surface processes

Historical development in concepts, terrestrial relief, scales in geomorphology,

Unit 2

Energy flow and relative energy of surface processes.

Weatheringandformation ofsoils,karstandspeleology,slopeandcatchmenterosionprocesses,fluvial, aeolian,glacial, peri-glacialandcoastalprocessesand resultantlandforms,,Waterandsedimentflux in riversystems, Morphometric analysis ofdrainage basinand geomorphology-hydrologyrelationshi

Unit 3

Rates and changes in surface processes

Techniques for measuring rates of processes: sediment budgeting, rock magnetism, isotope geochemical tracers, cosmogenic nuclides, OSL & C-14 dating

Unit 4

Controlling factors (tectonics, climate, sea level changes and anthropogenic) and surface processes

Climate change and geomorphic response of fluvial systems of arid and humid regions Geomorphic response to tectonics, sea level/base level change, anthropogenic affects Introduction to Anthropocene

Unit 5

Geomorphic concepts in cause-effect relationship

Spatial & temporal scales, geomorphic system, connectivity, buffering, magnitude-frequency concept, time lag, sensitivity, equilibrium, threshold, non-linearity & complexities

Mega geomorphology and process interrelationship

Surface processes and natural hazards; Applied aspects of geomorphology; Introduction to planetary geomorphology.

Practical

Mapping of different landforms and interpretation of surface processes

Exercises on hill slope development, fluvial channel, sediment erosion and transport, sediment budgeting, aggradation and degradation events, drainage basin, drainage morphometry

Basicexerciseson computationofratefordifferentsurfaceprocesses

References

1. Alien, P.A., 1997. *Earth Surface Processes,* Blackwell publishing.

2. Bloom, A.L., 1998. *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms,* Pearson Education.

3. Bridge, J.S. and Demicco, R.V., 2008. *Earth Surface Processes, Landforms and Sediment Deposits,* Cambridge University Press.

4. Esterbrook, D.J., 1992. *Surface Processes and Landforms,* MacMillan Publ.

5. Kale, V.S. and Gupta A 2001 *1ntoduction to Geomorphology,* Orient Longman Ltd.

6. Leeder, M. and Perez-Arlucea M 2005 Physical processes in earth and environmental sciences, Blackwell' publishing.

7. Summerfield M A 1991Globle *Geomorphology* Prentice Hall.

8. Wllcock, P.R., Iverson R M (2003) Prediction in geomorphology ' AGU Publication.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Surface Processes, cause-effect relationships, geomorphology, geochronology.

ESSENTIALS OF GEOLOGY (GEOLOGE1) Generic Elective - (GE) Credit:6

Course Objective(2-3)

1. Interactive and interdisciplinary nature of geology
2. Interplanetary scope of geology
3. Introduction to atmosphere, hydrosphere, biosphere and lithosphere

Course Learning Outcomes

1. Earth, its origin and concept of geological time
2. Formation of planets and solar system
3. Composition of inner as well as surficial components of planet earth
4. Major geomorphic features, and compositions of various parts of earth and major earth processes

Unit 1

Introduction to geology, scope, sub-disciplines and relationship with other branches of sciences

Unit 2

Earth in the solar system, origin

Earth's size, shape, mass, density, rotational and evolutional parameters

Solar System- Introduction to Various planets - Terrestrial Planets

Solar System- Introduction to Various planets - Jovian Planets

Internal constitution of the earth - core, mantle and crust

Unit 3

Convections in the earth's core and production of magnetic field

Composition of earth in comparison to other bodies in the solar system

Unit 4

Origin and composition of hydrosphere and atmosphere

Origin of biosphere

Origin of oceans, continents and mountains

Unit 5

Age of the earth; Radioactivity and its application in determining the age of the Earth, rocks, minerals and fossils

Practical

1. Study of major geomorphic features and their relationships with outcrops through physiographic

models.

2. Detailed study of topographic sheets and preparation of physiographic description of an area

3. Study of soil profile of any specific area

4. Study of distribution of major lithostratigraphic units on the map of India

5. Study of distribution of major dams on map of India and their impact on river systems

6. Study of major ocean currents of the World

7. Study of seismic profile of a specific area and its interpretation

References

1. Holmes' Principles of Physical Geology. 1992. Chapman & Hall.

2. Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.

3. Gross,M.G., 1977. *Oceanography: A view of the Earth*, Prentice Hall.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Planetary earth, lithosphere, hydrosphere, biosphere, atmosphere, geochronology

FOSSILS AND THEIR APPLICATIONS (GEOLGE7) Generic Elective - (GE) Credit:6

Course Objective(2-3)

To study different groups of invertebrate, vertebrate and plant fossils.

To learn the utility of some of these fossils in determining the relative age of sedimentary rocks.

To know the utility of various fossil groups in palaeoecological, palaeoenvironmental, palaeobiogeographical reconstructions.

Understand the role of fossils in hydrocarbon exploration.

Course Learning Outcomes

Student will learn about different types of life forms that existed in the geological past.

Will learn about the evolutionary rates of certain important fossil groups and their role in dividing the rocks into distinctive units based on their stratigraphic ranges.

Learn how fossils can be used in understanding the past environments, ecosystems, climate and distribution of land and sea.

Will also learn about role of fossils in the exploration of hydrocarbons.

Unit 1

Introduction to fossils

Definitionof fossil,fossilizationprocesses(taphonomy),taphonomic attributes and itsimplications, modesoffossilpreservation,roleof fossils indevelopmentofgeologicaltimescaleandfossils sampling techniques.

Unit 2

Species concept

Definition of species, species problem in paleontology, speciation, methods of description and naming of fossils, code of systematic nomenclature

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Unit 3

Introduction to various fossils groups

Briefintroductionofimportantfossilsgroups:invertebrate,vertebrate,microfossils,spore,pollensand plant fossils. Importantage-diagnostic fossiliferous horizons ofIndia

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Unit 4

Application of fossils

Principles and methods of paleoecology, application of fossils in the study of paleoecology, paleobiogeography and paleoclimate

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Unit 5

Societal importance of fossils

Implication of larger benthic and micropaleontology in hydrocarbon exploration: identification of reservoirs and their correlation. Application of spore and pollens in correlation of coal seams, spore and pollens as indicator of thermal maturity of hydrocarbons reservoirs, fossils associated with mineral deposits, fossils as an indicator of pollution.

Practical

1. Study of fossils showing various modes of fossilization

2. Distribution of age diagnostic fossils in India

3. Biostratigraphic correlation

References

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.

2. Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution George AlIen&Unwin

3. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.

4. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.

5. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, EdwinH. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Fossils, Biostratigraphy, Palaeoecology, Bathymetry, Palaeoclimate, Hydrocarbon Exploration, Palaeobiogeography

GEOTOURISM
(GEOLOGE13)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

This is an designed as an applied course where student learns to combine and optimize the tourism potential of spectacular geological features.

Course Learning Outcomes

1. Distinguishing and identifying potential geological sites of tourist interest

2. Spectacular (e.g. geomorphic landforms, structures) as well as intrinsic sites (major time boundaries, fossil sites, LIP's, transgressions regressions etc)

3. Economic aspects and linking geospots with other tourist destinations in a theme

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Unit 1

Tourism and its different forms and their interrelations.

Geotourism: definition, characteristics and international/national perspectives

Eco-tourism and Geo-tourism

Unit 2

Geology and Tourism

Geodiversity, geoheritage, geoconservation and their relationship to geotourism

Geotourism and cultural heritage

The application of geographical information systems in geotourism

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Unit 3

Education as a key tenet of geotourism and Earth Science Education & Geotourism

Geoheritage and public geoliteracy: opportunities for effective geoscience education within geosites

Earth Science Museums and their role in promotion of Geotourism

Examples of Geotourist sites from- e.g. Glacier features, Ox-bow lakes, Deltas etc.

Unit 4

Geotourism, Society and Sustainability

Public–private partnership framework for sustainable geopark development

Geotourism––a focus on the urban environment including historical geotourism

Potential of Geotourism in Economic development of any region.

Role of Tourism sector in terms of world economy/ Indian economy

Role of Geotourism in Tourism industry with special reference to Indian scenario- Entrepreneurship and start-up

Unit 5

Geotourism and geoparks

UNESCO Global Geoparks and Geoconservation

Geo site developed by Geological Survey of India

Practical

Geological Map of India

Plotting the established geosites, geoparks and geo monuments of India on map.

Plotting geosites, geoparks and geo monuments on map of World.

Detailed study of geosites of India-Locality, Approach, Geological importance and foot fall.

Five Case studies from India where geosites can be developed

References

The Principles of Geotourism, Anze Chen, Young C.Y. Ng, and Yunting Lu (Springer) (2015)

Global Geotourism perspectives, Dowling, R. K., & Newsome, D. (Eds) USA: Goodfellow Publishers Limited (2010)

Geotourism, Dowling, R. K., & Newsome, D. (Eds) Elsevier Butterworth- Heinemann (2006)

Appreciating Physical Landscapes: Three Hundred Years of Geotourism, T.A. Hose (Ed.), Geological Society Special Publication No. 417, London (2016)

Geoheritage and Geotourism- a European Perspective, Thomas A. Hose (Ed) Boydell Press Woodbridge, UK

Handbook on Geotourism, Ross Dowling&David Newsome (Eds) Edward Elgar Publishing(2018)

A monograph on National Geoheritage Monuments of India. Indian National Trust for Art and Cultural Heritage(INTACH) Natural Heritage Division, New Delhi (2016)

National Geological Monuments. Geological Survey of India, Kolkata, Special Publication No.6 1 (2001)

Landscapes and Landforms of India, Kale, V. S. (ed) Springer, Dordrecht (2014)

History of Geoconservation, C. V. Burek and C.D. Prosser (Eds.) Special Publication 300, Geological Society of London (2008)

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Geological features, geomorphology, nature tourism. geoparks, natural museum

HISTORY OF THE EARTH
(GEOLGE10)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

The objective of this course is to make a student aware of the rhythm and pulses of earth's physical, chemical an biological changes as recorded in rock sequences, their chemistry and fossil content respectively. To understand t future changes expected one must decipher the pattern of variations in these parameters through ages. This cour designed to make student aware of the history of various components of the Earth System.

Course Learning Outcomes

By completeing this course the students will be well worsed with the pattern of changes occuring in various spheres of earth through geological time from Barysphere to meso sphere, lithosphere, cryosphere, atmosphere, biosphere etc. A comprehensive understanding of all these aphere through geological time will enable the student to undserstand future of our planet.

Unit 1

Physical History of Earth

Origin of Planet Earth, Early evolution of Earth’s Atmosphere, Origin of Oceans. Earliest supercontinent and history of its breakup. Basic concepts of plate Tectonics and Wilson Cycle.

Unit 2

Chemical History of Earth

Early differentiation of the Earth’s layers. Mechanical and compositional layers of earth. Abundance of elements. Comparison of Earth’s chemistry with other planets of our Solar System

Unit 3

Biological History of Earth

Origin of life on Earth. Earliest record of life in Earth's rocks. Evolution from single cell to multicellular life. Ediacara Fauna and it's significance. Evolution of skeletal organisms. A brief overview of Paleozoic, Mesozoic and Cenozoic life.

Unit 4

Evolution of continents and oceans

Continental drift and sea floor spreading. History of Atlantic, Pacific and Indian Oceans. Separation of Gondwana land

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Practical

1. Excercises on major paleogeographical reconstruction with special reference to Indian sub continent.

2. Plotting of Global Stratotype Section and points on a world map

3. Distribution of Marine Rocks on world map in various geological time slices

4. Studying sea level changes through geological time

References

1. Life on a young Planet. Andrew H Knoll

Princeton Science Library

2. The story of Earth : The first 4.5 billion years.

Robert Hazen 2012. Penguin

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Geological Time, Paleoclimate, Fossils, supercontinent, evolution

INTRODUCTION TO SUSTAINABILITY (GEOLGE8) Generic Elective - (GE) Credit:6

Course Objective(2-3)

The main aim of this course is to introduce the fundamental concepts of sustainability. It will discuss about the ecosystems, energy, and natural resources.

Course Learning Outcomes

A student will learn about the concept of sustainability. They will also learn about the challenges faced by present and future generations regarding natural resources. They will also learn about the measures that can be taken to meet the challenges.

Unit 1

Introduction to Sustainability; basic concepts; Human Population – Past and Future trends

Unit 2

Ecosystems; Extinctions and Tragedy of Commons; Climate and Energy; Water Resources and Agriculture

Unit 3

National Resources Accounting Environmental Economics and Policy Measuring Sustainability; Systems interconnectivity among Primary Sustainability challenges; Sustainability Solutions: Some examples

References

1. Rogers, P.P., K. F. Jalal, and J.A. Boyd. 2007. An Introduction to Sustainable Development.

Earthscan Publishers, 416 pp.

2. Brown, L. 2009. Plan B 4.0. Norton Publishers, New York. (The entire book is available in pdf format: http://www.earthpolicy.org/images/uploads/book_files/pb4book.pdf)

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Sustainability, Natural Resources, Environmental Economics, Economic Policy

NATURAL HAZARDS AND DISASTER MANAGEMENT (GEOLGE5)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

To create awareness and knowledge base of different types of natural disasters.

To understand the management of natural disasters.

Course Learning Outcomes

1. Definition and types of natural disasters

2. Geological basis of water related disasters such as floods etc;

3. Landslide hazard mapping techniques

4. Earthquakes and seismic hazards

4. Forecasting and management of natural hazards

Unit 1

The Lithosphere and Related Hazards
Atmospheric Hazards, Hydrosphere and Related Hazards

Unit 2

Concepts of disaster
Types of disaster: natural and manmade - cyclone, flood, land slide, land subsidence, fire and earthquake, tsunami and volcanic eruption

Unit 3

Tectonics and Climate, Meteorite Impacts
Issues and concern for various causes of disasters
Disaster management, mitigation, and preparedness
Techniques of monitoring and design against the disasters
Management issues related to disaster

Unit 4

Disaster Management in India
Risk, Vulnerability and Hazard
Mitigation through capacity building
Legislative responsibilities of disaster management; disaster mapping, assessment
Pre-disaster risk & vulnerability reduction
Post disaster recovery & rehabilitation
Disaster related infrastructure development

Unit 5

Hazard Zonation Mapping
Remote-sensing and GIS applications in real time disaster monitoring
Prevention and rehabilitation

Practical

The course will also include discussions on topics determined by students in Tutorial. There would be 12 student presentations apart from the lectures. The topics would be assigned to students based on their interest.

Practicals will be by tutorials

References

1. Bell, F.G., 1999. Geological Hazards, Routledge, London.
2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.
3. Smith, K., 1992. Environmental Hazards. Routledge, London.
4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Natural disasters, hazard zonation, landslides, floods, earthquakes

PHYSICS AND CHEMISTRY OF EARTH
(GEOLGE3)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

1. Students will come to know the dynamism in Earth processes
2. Students will be provided an idea about nucleosynthesis and elemental distribution in the Earth
3. Students will be appraised of concepts of Earth's magnetism
4. An dia of chemical character of the Earth

Course Learning Outcomes

Students will be able to understand different physical and chemical processes of the Earth

Unit 1

Earth: surface features

Continents, continental margins, oceans

Unit 2

Earth’s interior - variation of physical quantities and seismic wave velocity inside the earth, major sub divisions and discontinuities.

Concepts of Isostasy; Airy and Pratt Model

Core: Seismological and other geophysical constraints

The geodynamo - Convection in the mantle

Unit 3

Elements of earth’s magnetism. Secular variation and westward drift Solar activity and magnetic disturbance

Unit 4

Elements: Origin of elements/nucleosynthesis. Abundance of the elements in the solar system / planet earth Geochemical classification of elements.

Earth accretion and early differentiation

Isotopes and their applications in understanding Earth processes. Stable isotopes: Stable isotope fractionation. Oxygen isotopes Sublithospheric Mantle (Mineralogy/phase transitions)

Unit 5

Environmental geochemistry

Geological disposal of nuclear waste

Lead in environment and effect of lead on human health

Practical

1. Projection of major elements on binary and triangular diagrams for rock classification

2. Projection of major element data on Harker's diagram to characterize magmatic differentiation

3. Study of trace elements through a) Projection of chondrite/primitive normalized trace elements to characterize sources b) Projection of trace elements on tectonic discrimination diagrams

4. Understanding Earth structure through behavior of seismic wave propagation

5. Problems on isostasy

References

1. Holmes, A., Principles of Physical Geology, 1992, Chapman and Hall
2. Condie, K.C. Plate Tectonics and Crustal Evolution, Pargamon Press, 1989.
3. Krauskopf, K. B., & Dennis, K. Bird, 1995, Introduction to Geochemistry. McGraw-Hill
4. Faure, G. Principles and Applications of Geochemistry, 2/e (1998), Prentice Hall, 600 pp.

Additional Resources:

1. Anderson, G. M. (1996). Thermodynamics of natural systems. John Wiley & Sons Inc.

2. Steiner, E. (2008). The chemistry maths book. Oxford University Press.

3. Yates, P. (2007) Chemical calculations. 2nd Ed. CRC Press.

Teaching Learning Process

Regular class

Assignment

Seminar, Interactive discussion
Quiz

Assessment Methods

Seminar

Exam
Internal Assessment
Assignment

Keywords

Isostacy, Magmetism, Geodynamo, nucleosynthesis, Isotope

PLANETARY GEOLOGY
(GEOLOGE11)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

The background knowledge on the planetary material. interiors as well as processes including the planet formatio processes

Course Learning Outcomes

1. Origin of planets
2. Planetary features including those of the exoplanets
3. Remote sensing techniques in planetary characterization
4. Impact cratering- rates and causes
5. Planetary surface processes and interiors

Unit 1

Introduction to Planetary Geology, Planetary configuration and description

The Big Bang & Early Solar System History

Unit 2

The Era of Planetary Formation

Impact Craters: A Geologic Process and Markers of Time

Meteorites: the building blocks of planets- Classification and types

Asteroids

Unit 3

Techniques in planetary science- Remote techniques

The Moon: Formation & Evolution, Internal structure, composition, water on the moon

Mercury and the MESSENGER Mission

Venus: Earth’s Twin?

Unit 4

The early Earth and primary geochemical differentiation, the first billion years and emergence of life, the great oxidation event and search for life beyond earth

Planetary surface and interior processes, Atmosphere

Mars- Results from the Curiosity Rover, Climatic Evolution & Prospects for Life

Unit 5

Saturn: Rings & Strange Moons, structure

Pluto

Exoplanets and search for earth like planets

Practical

Geologic events on earth

Geological features seen on aerial photographs (emphases on Moon and Mars)

Satellite imagery data of planets and data interpretation

Planetary feature on earth and moon

References

Planetary Geology by Angelo Pio Rossi and Stephen van Gesselt (Eds.) Springer, 2017

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Craters. atmosphere, exoplanets, impact features, remote sensing

ROCKS AND MINERALS
(GEOLGE2)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

1. Introduction of different types of rocks and Minerals
2. General idea on processes involved in formation of minerals and rocks
3. Structure of Earth and distribution of rocks

Course Learning Outcomes

1. Students will be acquainted with different types of rocks and minerals
2. Students will come to know veracity of geological processes and formation of different rock types
3. Students will know structure of the Earth and distribution of rocks

Unit 1

Minerals-Definitions, Physical properties of minerals Mineralogical structure of earth, planetary minerals and native elements

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Unit 2

Mineral structures

Mineralogy of the Earth's crust, mantle and core

Unit 3

Nature of light and principles of optical mineralogy

Optical classification of minerals.

Unit 4

An overview of environmental and radiation mineralogy, biomineralisation and gemology.

Unit 5

Rocks- Definitions and types, Basics of rock formation. Igneous rock- magma generation and differentiation

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Unit 6

Sedimentary rocks- surface processes and sedimentary environments

Metamorphic rocks- chemical system and types of metamorphism

Rock cycle-interactions between plate tectonics and climate systems

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Practical

1. Study of physical properties of minerals

2. Introduction to optical microscopy

3. Study of optical properties of minerals

4. Study of physical properties of rocks

5. Study of optical properties of rock under thin sections

6. Understanding crystal symmetry via wodden models

7. Stereographic projection of mineral faces

8. Mineral formula calculation

9. Crystal chemical calculation

10. Introduction to analytical techniques for rock and mineral study.

References

Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts,

Cambridge University Press, 2013.

Additional Resources:

Additional Resources:

UnderstandingEarth(Sixth Edition),JohnGrotzingerandThomasH.Jordan, 2010, W.H. Freeman and company, New York.

Teaching Learning Process

Regular class

Seminar

Hand specimen study of different rocks and minerals

Assignment

Assessment Methods

Internal Assessment, Seminar, Interactive Discussion, Examination

Keywords

Rock, Mineral, Igneous, sedimentary, Metamorphic, silicate, carbonate, Oxide

SOILS: PAST AND PRESENT
(GEOLOGE12)
Generic Elective - (GE) Credit:6

Course Objective(2-3)

1. Students will be given idea about different soil forming processes
2. Modern soils and key pedofeatures
3. Geological record of fossil soils

Course Learning Outcomes

1. Students will have idea on soil forming processes
2. Students will come to know recognizing criteria of paleosol
3. Students will have idea on geological record of fossil soils

Unit 1

Soil forming processes: Chemical weathering, major buffer maintaining ocean/atm/biosphere O2 and CO2, new compounds/minerals of greater volume and lower density; Oxidation; Carbonation; Hydrolysis; Hydration; Base Exchange; Chelation; Microbial weathering

Unit 2

General soil forming regimes: Gleization; podzolization; lessivage; ferrallitizatin; calcification;

salinization

Soil forming processes: Physical weathering, loosening and particle size reduction; pressure release; thermal expansion; growth of foreign crystal.

Unit 3

Modern soils and key pedofeatures: Soil structures; horizons; roots; Fe-Mn mottles and concretions;pedogeniccarbonate

Unit 4

Introduction to paleopedology and paleosols; role of factors controlling paleosol formation- parent material, climate, vegetation, topography, time.

Introduction to soil taxonomy and paleosol taxonomy

Unit 5

Micromorphology: Thin section analysis of paleosols

Geochemistry: molecular rations; chemical weathering indices

Stable isotope geochemistry: carbon13 and oxygen18 system for vegetation, temperature, pCO2

Diagenetic overprinting in fossil soils: compaction; oxidation of organic matter; cementation;

illitization

Unit 6

Geological record of fossil soils- Precambrian paleosols- evolution of paleoatmospheric conditions

Geological record of fossil soils- Paleozoic paleosols- evolution of land animals and plants, coal, Permian-Triassic transition paleosols and extinction events

Geological record of fossil soils- Mesozoic-Cenozoic paleosols- fossil soils at K-T extinction event, Paleogene fossil soils at green house to ice house transition, evolution of Asian monsoon system.

Pleistocene-Holocene paleosols- human impact on landscape and soils, climate change, neotectonics.

paleosols and non-marine sequence stratigraphy based on paleopedology and sedimentology of fluvial successions.

Practical

1- Micromorphic detailing of the paleosols- structure, horizonation, color, rhizocretions, pedogenic carbonate etc.

2- Particle size analysis and clay mineral analysis of the paleosols

3- Micromorphological analysis- thin section preparation, description, and interpretation

4- Geochemical analysis- bulk geochemistry, molecular rations and weathering indices

5- Field trip to examine modern and fossil soils- field characterization and sampling procedures

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References

1. Retallack, G.J. (2001) *Soils of the Past: An Introduction to Paleopedology* (2nd edition): Oxford, Blackwell Science, Ltd., 416 p.

2. Birkeland, P.W. (1999) Soil and Geomorphology. Oxford University Press (430 pp.).

3. Bullock, P., Fedoroff, N., Jongeroius, A., Stoops, G., Tursina, T. (1985) Handbook of Soil Thin

Section Description. Waine Research Publication, Wolverhampton (152 pp.).

Additional Resources:

4. Sheldon, N.D., Tabor, N.J. (2009) Quantitative paleoenvironmental and paleoclimatic reconstruction using paleosols. Earth-Science Reviews 95, 1–52.

1. Stoops, G. (2003) Guidelines for analysis and distribution of soil and regolith thin sections. Soil

Sci. Soc. Am., Madison, Wisconsin, 184 pp.

2. Soil Survey Staff, (2006) Key to Soil Taxonomy, 10th ed. USDA Natural Resources

Conservation Service, Washington D.C.(341 pp.)

3. Bhattacharyya T., Sarkar, D., Pal, D. K. (Eds.) **Soil Survey Manual.** NBSSLUP Publication No

146.

Teaching Learning Process

Regular class

Assignment

Seminar

Quiz

Assessment Methods

Internal Assessment (Seminar and Assignment)

Quiz

Examination

Keywords

Soil, Paleosol, Paleopedology, Permo-Triassic, Pleistocene-Holocene

WATER QUALITY AND MANAGEMENT (GEOLGE9) Generic Elective - (GE) Credit:6

Course Objective(2-3)

To understand about the fundamentals of: groundwater management and water quality issues.

Course Learning Outcomes

The course will impart basic understanding about: groundwater science; aquifers; groundwater flow and groundwater management principles and practices. The concepts of water quality; water quality parameters and criteria for portable and irrigation use; contamination and pollution and graphical representation of the water quality data.

Unit 1

Water science and its societal relevance, Hydrologic cycle and interaction of the surface and subsurface water, Vertical distribution of subsurface water.

Unit 2

Introduction to the concept of porosity and permeability, classification of rocks and sediments as aquifer, aquitard, aquiclude and aquifuge. Types of Aquifer, concept of the piezometric surface and water table and aquifer parameters.

Unit 3

Introduction to Darcy's law and the concept of : static water level, pumping water level, drawdown, radius of influence, cone of depression, specific capacity etc.

Unit 4

Introduction to: the basic concept of water balance and the groundwater resources estimation; principles of the groundwater management; rainwater harvesting and artificial recharge to groundwater; aspects of watershed management as an integral part of groundwater management .

Unit 5

Introduction to the concept of water quality, contamination, pollution and water quality parameters: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), organoleptic; physical; chemical; radioactive and bacteriological parameters.

The criteria for portable and irrigation use and graphical representation of the water quality data.

Practical

Preparation and interpretation of water level contour maps and depth to water level maps.

Graphical representation of chemical quality data and water classification (Trilinear diagrams).

Fundamental exercise on groundwater resources estimation.

Basic fundamental exercises on aspects related to designing rainwater harvesting and artificial recharge structures.

References

Todd, D. K. (1980). *Groundwater hydrology, 2ed*. John Wiley. (p. 535).

Karanth K.R., 1987, Groundwater: Assessment, Development and management, Tata McGraw- Hill Pub. Co. Ltd.

Additional Resources:

Freeze, R. A., & Cherry, J. A. (1979). Groundwater (p. 604). *New Jersey: Prentice Hall Inc Englewood cliffs*.

Syed Tajdarul Hassan. 2017. Introduction to Hydrology. E-PG Pathshala, UGC, MHRD, Govt. of India.

Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank . 2017. Aquifer Properties. E-PG Pathshala, UGC, MHRD, Govt. of India.

Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank. 2017. Darcy’s law. E-PG Pathshala, UGC, MHRD, Govt. of India.

Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Shekhar Shashank. 2017. Assessment of groundwater quality. E-PG Pathshala, UGC, MHRD, Govt. of India.

Available on: https://epgp.inflibnet.ac.in/ahl.php?csrno=448

Teaching Learning Process

Lectures, Practicals, Seminar, Tutorials, Assignments.

Assessment Methods

Tests, Quiz, Debates and Presentations.

Keywords

Water Science; groundwater; groundwater flow; water quality; water balance; groundwater managment