Department Of Earth Sciences
Pondicherry University, Pondicherry-605014, India

M.Sc. Integrated Course in Applied Geology (5 years)

Course Structure for first 6 semesters

Sem #	Course #	Hard-core courses	Credit
1		Mathematics I	3
		Physics I	3
		Chemistry I	3
	EASC 111	**Earth & Environment**	3
		Physics Lab I	2
		Chemistry Lab I	2
		Semester Total	**16**
2		Mathematics II	3
		Physics II	3
		Chemistry II	3
	EASC 121	**Paleontology**	3
		Physics Lab II	2
		Chemistry Lab II	2
		Semester Total	**16**
3	**EASC 211**	**Crystallography and Mineralogy**	3
	EASC 212	**Structural Geology and Tectonics**	3
	EASC 213	**Geology Lab I-Structural Geology & Mineralogy**	2
		Semester Total	**8**
4	**EASC 222**	**Igneous and Metamorphic Petrology**	3
	EASC 223	**Sedimentology**	2
	EASC 224	**Geology Lab II -Igneous & Metamorphic Petrology, and Sedimentology**	2
		Semester Total	**7**
5	**EASC 311**	**Mineral and Fossil Fuel Resources**	3
	EASC 312	**Stratigraphy and Indian Geology**	3
	EASC 313	**Geochemistry**	3
	EASC 314	**Geology Lab III – Ore petrography & geochemistry**	2
		Semester Total	**11**
6	**EASC 321**	**Geohydrology and Engineering Geology**	3
	EASC 322	**Geomorphology and Remote Sensing**	3
	EASC 323	**Field Training I - Geological Field work and Mapping**	3
	EASC 324	**Geology Lab IV – Remote Sensing and Geohydrology**	2
		Semester Total	**10**
Total for the first 6 semesters			**68**

Note: The course structure and syllabus for 7th, 8th, 9th and 10th semester of M.Sc. Integrated Course in Applied Geology are same as those of 1st, 2nd, 3rd and 4th semester of 2 year M.Sc course in Applied Geology respectively.

EASC 111 - The Earth and Environment 3 credits

This course aims to initiate students in to problems of how the earth was formed and how it works. This course will develop an understanding of dynamics of solid part of the earth, oceans, atmosphere and life and their interactions. It also deals with how these interactions manifests in global phenomenon such as global climate change.

Unit I Introduction

Origin of the Earth: The Origin of Planets, Early Earth and Formation of a Layered Planet, Earth as a System of Interacting Components, Earth Through Geologic Time.

Plate Tectonics: The Discovery of Plate Tectonics, The Mosaic of Plates**,** Rates and History of Plate Motions, The Grand Reconstruction, The Engine of Plate Tectonics.

Unit II Earth Materials

Minerals: The Atomic Structure of Minerals. Rock-Forming Minerals, Properties of Minerals.

Rocks: Igneous Rocks, Sedimentary Rocks, Metamorphic Rocks. The Rock Cycle, Rock and Fossil Record and the Geological Time Scale**.**

Mineral Resources: Geology of Mineral Deposits, Material Resources

Unit III Earth Processes

Dynamic Processes of Solid Earth: Folds, Faults, and other Records of Rock Deformation, Earthquakes, Evolution of the Continents, Tectonics of Indian Plate, Origin of Himalayas

Weathering and Erosion: Physical weathering, Chemical weathering, **Mass Wasting, Glaciers,** Ice Ages.

Natural Hazards: Volcanism, Earthquakes, Tsunamis, Issues relating to prediction, protection and mitigation. **Landscapes,** Tectonic and Climate Interaction

Unit IV Hydrosphere & Atmosphere

The Hydrologic Cycle and Groundwater, Water Quality**. Streams,** Stream Loads and Sediment Movement, Deltas. **Winds and Deserts,** Atmospheric circulation, wind erosion**. The Oceans,** Continental Margins**,** Physical and Chemical Sedimentation in the Ocean, Waves and Tides, Shorelines.

Unit V Energy, Environment and Global Change

Energy Resources: Oil and Natural Gas, Coal, Alternatives to Fossil Fuels, Conservation Energy Policy. **Environment, Global Change, and Human Impacts,** The Climate System**,** Natural Climate Variability**,** The Carbon Cycle, Human Activity and Global Change.

Text Books:

1. Frank Press Raymond Siever: Understanding Earth (3rd ed). W.H. Freeman and Company. New York . 2000
2. B. J. Skinner and S.C. Porter: The Dynamic Earth – An Introduction to Physical Geology 3rd edition. John Wiley & Sons, New York. 1995
3. P. McL. D. Duff : Holme's Principles of Physical Geology (4th ed). Chapman & Hall. London. 1996

Reference Books:

1. A. Cox & R.B. Hart Plate Tectonics How it works. Blackwell Scientific Publ. Co. Boston. 1986.
2. Philip A. Allen Earth Surface Processes Blackwell Sciences Ltd, Oxford 1997
3. B.W. Murck, B.J. Skinner & S.C. Porter Dangerous Earth – An Introduction to Geologic Hazards John Wiley & Sons New York 1996
4. B.W. Murck, B.J. Skinner & S.C. Porter, Environmental Geology. John Wiley & Sons, New York, 1996.

Credits: 3

EASC–121 Paleontology

Pre requisite: EASC 111 - Earth and Environment or Teacher's consent

Unit –I : The organic world; fossils and processes of fossilization; Geological time scale; types of fossils and their uses.

Unit –II : A brief knowledge of morphology and distribution of the following group of invertebrates – Protozoa, Coelenterata Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Echinodermata, Graptoloidea and Trilobita.

Unit –III : Brief account of geological distribution of important Gondwana flora in India. Siwalik vertebrate fossils. Paleontology-field trip of 4 days duration.

Unit –IV : An outline of life through ages, its evolution and distribution

Unit –V : Laboratory work – Megascopic study of major invertebrate fossils. Study of some important microfossils under binocular microscope.

Text Books:

1. Shrock,R.R and Twenhofel,W.H. 1987. Principles of Invertebrate Paleontology. McGraw Hill, New York.

2. Jain, P.C and Anantharaman, M.S., 2005. Palaeontology : Evolution and Animal Distribution. (6th edition), Vishal Publishing Co, New Delhi.

3. Moore,R.C, Lalicker, C.G & Fisher, A.G (1997). Invertebrate fossils. (1st Indian edition), CBS Publishers & Distributors, New Delhi.

Laboratory Book :

1. Woods, H. 1982. Invertebrate Paleontology, CBS Publishers, New Delhi.

Reference Books:

1. Clarkson , E.N. 1993.Invertebrate Paleontology and Evolution, Chapman Hall India, Chennai.

2.. Raup, D.M. and Stanley,S.M. 1985. Principles of Paleontology, CBS Publishers, New Delhi.

EASC 211 – Crystallography and Mineralogy

Credits: 3

Course Content: Crystallography and crystal chemistry, physical properties of minerals and descriptions of minerals.

Pre requisite: EASC 111 - Earth and Environment or Teacher's consent

Crystallography

Unit

1. Introduction: Definition of mineral. References on crystallography and mineralogy, Concept of crystal, translational symmetry, Point symmetry, 32 point groups, crystal faces, crystallographic directions, zones, crystal forms, forms in six crystal systems, crystal habit.
2. Crystal structure: controls of crystal structure, Application of Pauling's rules, Illustrating mineral structures, Isosturctural minerals, Polymorphism, Compositional variations, and Graphic representation.
3. Crystal nucleation and growth, structural defects, Post-crystallization processes.
4. Introduction to X-ray crystallography: X-rays and X-ray diffraction, Powder method, Determination of unit cell parameters.

Mineralogy

5. Physical properties of minerals: Density & specific gravity, mechanical cohesion, color and luster, magnetism, electrical properties
6. Optical Mineralogy: Light, interaction of light and matter, Petrographic microscope, Isotropic and anisotropic minerals, color and pleochroism, extinction angle and sign of elongation and interference color and order.
7. Silicates: crystal structure and classification of silicates, Crystallization occurrence of Minerals in igneous, metamorphic and sedimentary rocks
8. Ortho silicates, Ring & Di silicates, Chain silicates, Sheet silicates and Framework silicates.
9. Carbonates, Sulfates, Phosphates, Tungstates, Molybdates, Borates, Oxides, Hydroxides and Halides.
10. Sulfides and related minerals and Native elements.

Text Books:

1. W. D. Nesse, (2000), Introduction to Mineralogy, Oxford University Press, ISBN 0-19-510691-1
2. D. Perkins, (2002), Mineralogy, 2nd Edition, Pearson Education (Singapore) Pte. Ltd, Delhi, 483pp, ISBN 81-7808-831-2

Reference Books:

1. W.A. Deer, R. A. Howie and J. Zussmann (1992), An Introduction to Rock Forming Minerals, Longman Group Ltd., London, 696pp.
2. W.A. Deer, R. A. Howie and J. Zussmann, (1962-1982), Rock Forming Minerals (5 volumes), John Wiley & Sons, New York.
3. F. D. Bloss, (1971), Crystallogrphy and Crystal Chemistry, Holt, Rinehart, Winston, New York, 545pp.

EASC 212 – Structural Geology and Tectonics

Credits: 3

Pre requisite: EASC 111 - Earth and Environment or Teacher's consent

Unit-1: Concept of force and stress. Normal stress and shear Stress. Stress components. Hydrostatic and deviatoric stresses. Concept of strain. Nature of strain. Pure shear and simple shear. Concept of strain ellipsoid. Behaviour of materials under stress. Concept of deformation. Elastic and plastic behaviour of rocks. Brittle and ductile deformation.

Unit -2: Morphology, geometrical characteristics and classification of structures

Unit -3: Folds: Basic fold geometry, nomenclature and definitions. Classification of folds. Describing folds. Interference and superposition of folds. Folds and ductile deformation.

Unit -4: Faults: Fault geometry, nomenclature and definitions. Classification of faults. Features associated with fault plane and criteria for recognizing fault in field. Faulting and earthquakes. Concept of Shear zone.

Unit -5: Joints: Nomenclature and definitions related to joints and joint related structures. Classification of joints.

Unit -6: Linear structures: Lineations, cleavages and foliations. Morphology and description of lineations and cleavages, cleavages on different scales. Significance of linear structures.

Unit -7: Unconformity: Concept of unconformity, types of unconformity, criteria of recognition, significance of unconformity

Tectonics:

Unit -8: Continents and Oceans, Mountain ranges, Oceanic ridges and trenches, Stable and unstable tectonic zones.

Unit -9: Introduction to plate-tectonics, Historical development of the concept of plate-tectonics-continental drift,. Sea-floor spreading; Concept of lithosphere and lithospheric plates.

Unit -10: Nature of plate boundaries. Hot-spots and mantle plumes. Geological structures associated with different plate boundaries.

Text Books:

Davis, G.H., Reynolds, S.J., 1996, **Structural geology of rocks and regions**, 2nd Edition, John Wiley & sons.

Hamblin, W.K., Christiansen, E.H. 2003, **Earth's Dynamic Systems,** 10th Edition, Prentice Hall.

Reference Books:

Turcotte, D.L., & Schubert, G., 2001, **Geodynamics** 2nd Edition, Cambridge University Press

Pollard, D.D. & Fletcher, R.C. 2005, **Fundamentals of Structural Geology**, Cambridge University Press

Park, R. G., 1983, **Foundations of structural Geology**, Blackie Academic and Professional

Ramsay, J.G. & Huber, M.I. 1984, **The Techniques of Modern Structural Geology, Vol 1: Strain Analysis**, Academic Press

Ramsay, J.G. & Huber, M.I. 1987, **The Techniques of Modern Structural Geology, Vol 2: Folds and Fractures,** Academic Press.

Moores, E.M., Twiss, R.J. 1995, **Tectonics,** W.H. Freeman

EASC 213: Geology Lab I – Structural Geology, Crystallography and Mineralogy

Credits: 2

Structural Geology

Drawing exercises for Attitude of planes and lines: True and Apparent dip, strike, pitch, plunge, trend. Concept of structure contours and determining outcrop pattern. Interpretation of geological maps- determining exact attitudes from outcrop. Determining straightigraphic thickness. Constructin straightigraphic columns. Construction of a geological cross-section.

Crystallography and Mineralogy

Study of symmetry in models (quartz, tourmaline, barite, gypsum, augite, hornblende),

Study of symmetry and forms in the models (Fluorite, garnet, pyrite, tetrahedrite,galena, zircon, beryl, calcite, olivine, orthoclase, albite)

Study of color, streak, luster, cleavage, fracture, hardness (Moh's scale), magnetism and forms of the minerals. Determination of specific gravity of minerals.

Study of isotropic, uniaxial and biaxial common rock forming minerals under petrological polarizing microscope and determination of relative refractive indices (RI), pleochroism, extinction angle interference color and order.

Suggested readings:

Rowland, S. Duebendorfer, E. & Schiefelbein, I. 2006, **Structural Analysis and Synthesis, A Laboratory Course in Structural Geology**, 3rd Edition Blackwell Publishers

Ehlers E.G. (1987) **Optical Mineralogy: Theory and Techniques,** Blackwell Scientific Publications, 158 p. New York, John Wiley & Sons, Inc., 192p.

Klein, C, Hurlbut, C.S., and Dana, J.D. 1998, **Manual of Mineralogy (after James D. Dana), 21st Edition,** John Wiley & Sons Inc.

Mackenzie, W.S. & Adams, 1994, A.E. **Color Atlas of Rock and Minerals in Thin Section,** John Wiley & Sons

EASC 222 – Igneous and Metamorphic petrology

Credits: 3

Pre requisite: EASC 111 - Earth and Environment or Teacher's consent

Unit

1. Introduction: Concept of heat and temperature inside the Earth. Melting and crystallization. Magma and magmatic processes. Concept of intrusion and extrusion.

2. Forms and types of igneous bodies:- extrusive bodies- Flood basalts, Volcanoes and types of volcanoes. Pyroclastic deposits. Intrusive bodies:- concept of concordant and discordant intrusion, Dikes and sills and types of dikes, breccia pipes, Laccoliths, Lopoliths, Stocks and Batholiths.

3. Structure and textures of igneous rocks. Classification of igneous rocks- concept of mode and norm. Phase rule and concept of phase diagrams. Mineralogical and chemical description and significance of important igneous rocks of continental and oceanic association.

4. Concept of metamorphism- Changes in pressure and temperature. Equilibrium and non-equilibrium reactions. Agents of metamorphism. Types of metamorphism, metamorphic grade and facies of metamorphism.

5. Texture, structure and classification of metamorphic rocks. Pressure-temperature-composition diagrams for paragenitic studies. Metamorphism and deformation.

Text Books:

1. Best, M.G., 2002, **Igneous and metamorphic petrology,** 2nd Edition, Blackwell Publishers

Reference Books:

1. Philpots A.R., 1990, **Principles of Igneous and metamorphic petrology,** Prentice Hall.
2. Yardley, B.W., 1989, **An introduction to metamorphic petrology,** Longman

EASC 223 – Sedimentology

Credits: 2

Pre requisite: EASC 111 - Earth and Environment or Teacher's consent

Unit

1. Surface Geology and Sedimentation: Introduction to the Processes and factors influencing genesis of sediments.Weathering, soil formation, erosion and transport of debris and their deposition and conversion to rocks.Texture and Petrography of Clastic Rocks
2. Methods of description and classification of sediments and sedimentary rocks:

   Siliciclastic, Carbonate, and Chemical deposits and brief introduction to their origin
3. Flow mechanics and sedimentary structures
4. Depositional environment of sedimentary rocks, Burial and lithification.
5. Determination of provenance and Paleoenvironment. Introduction to facies concept. Distribution of Major Sedimentary rocks in various basis India

Text Books:

1. Sengupta, S.M. (1994) Introduction to Sedimentology, Oxford & IBH.
2. Tucker, M.E. (1981) Sedimentary Petrology: an introduction. John Willey & Sons, New York.

Reference Books:

1. Blatt, Middleton & Murray (1980) Origin of sedimentary rocks. Printice Hall Inc.
2. Pettijohn, F.J. (1975) Sedimentary rocks. Harper and Row Publ., New Delhi.
3. Prothero, D.R., Schwab, F., (2003) Sedimentary Geology. W. H. Freeman; 2nd edition
4. Allen, J. R. L (2001) Principles of Physical Sedimentology by Blackburn Press; 1st, corrected reprint edition (February 1, 2001)

EASC 224: Geology Lab II- Igneous & Metamorphic Petrology, and Sedimentology

Credits: 2

Igneous and Metamorphic petrology

Study of hand specimen of various igneous and metamorphic rocks.

Preparation of thins-section for microscopic study.

Microscopic study of mineralogical and textural characteristics of igneous and metamorphic rocks.

Sedimentology

Study of clastic and non-clastic rocks in hand specimen.

Petrographic study of sedimentary rocks in thin-sections using microscope.

Plotting of size distribution data.

Suggested readings:
Philpotts, A. R.: Atlas of Igneous and metamorphic rocks under the microscope

Hard Core Course 3 Credits

EASC-311 MINERAL AND FOSSIL FUEL RESOURCES

Pre requisite: or Teacher's consent

Unit 1: Economic minerals: chemical and industrial classification. Concept of ore minerals and gangue minerals; tenor and cut-off grade. Physical properties, chemical composition and mode of occurrence of important ore minerals, industrial minerals, fossil fuels and building stones.

Unit 2: Mineral deposits – types, morphology and forms of ore bodies. Spatial distribution of mineral deposits and their distribution through geological time. Genetic classifications of mineral deposits. Ore forming processes and physical-chemical environment of ore deposition. Magmatic (early magmatic, late magmatic, volcanic), sedimentary (syn-sedimentary, diagenetic), metamorphic, hydrothermal, and weathering-surface processes of ore formation. .

Unit 3: Geological characteristics and Indian occurrences of important types of magmatic deposits (chromite, titaniferous magnetite, Cu-Ni sulphide), pegmatitic deposits (muscovite and rare metals), skarn deposits and hydrothermal deposits (base metals, gold, tin, tungsten, molybdenum), and metamorphic deposits (gondite-type manganese, graphite).

Unit 4: Geological characteristics and Indian occurrences of sedimentary deposits (Banded iron formation, manganese), lateritic deposits (aluminium). various types of coal deposits, and oil and natural gas occurrences. Petroleum reservoirs and various types of oil and gas traps. On-shore and off-shore petroliferous basins of India. Other important hydrocarbon resources (coal bed methane, gas hydrate).

Unit 5: Basic concepts of prospecting and exploration of mineral and fossil fuel resources. Geological, geochemical and geophysical methods of exploration. Elementary ideas on methods of mining – open cast and underground methods. Principles of mineral economics – strategic, critical and essential minerals; conservation of minerals. National mineral policy of India.

Text Books:

1. A.M.Evans. 1981. An introduction to ore geology. Elsevier.
2. R.K.Sinha and N.L.Sharma. 1988. Mineral economics. Oxford-IBH, New Delhi.

Further Readings:

1. Jensen, M.L. & Bateman, A.M. 1981. Economic mineral deposits. John Wiley & Sons, New York.
2. L.Robb. 2004. Introduction to Ore-forming Processes. Blackwell Science, UK,384 p.
3. P.K. Banerjee and S.Ghosh 1997. Fundamental principles of prospecting. Allied Publishers.
4. S. Krishnaswami, S. 1988. Mineral resources of India. Oxford-IBH, New Delhi.

EASC – 312 Geology VII : Stratigraphy and Indian Geology

Credits: 3

Unit –I : Scope of the subject, its relationship with other disciplines. Principles of stratigraphy. Geological time scale.

Unit –II : An outline of Stratigraphic classification . Correlation , facies and unconformities.

Unit –III : Physiographic divisions of India. Major stratigraphical divisions and their equivalents in India. Brief account of classification, lithology, structures and fossil content of Archaean, Cuddapah and Vindhyan Super Groups.

Unit –IV : An outline of Paleozoic rocks and Gondwana Super group – their classification, lithology, fossils and distribution in India. Brief knowledge on distribution, lithology , fossil content and classification of Triassic, Jurassic and Cretaceous rocks of India.

Unit–V : Short account of Deccan Traps – Intra and Inter trapeans – Origin, composition, distribution. Tertiary and Quaternary rocks of India.

Text Books:

1. Lemon,R.R .1990. Principles of stratigraphy.. Merrill Publ. New York
2. Boggs,S.1987. Principles of Sedimentology and Stratigraphy, Merrill, NewYork.

Further Readings:

1. Krishnan, M.S. 1982. Geology of India and Burma. CBS publishers, New Delhi

EASC-313 Geochemistry

Credits 3

Unit I Stellar evolution and origin of elements. Different processes of nucleosynthesis. Abundances of elements, Oddo-Harkin Law, Meteorites, Chondrites and chondritic ratios. Origin of the solar system and distribution of elements with respect to distance from the Sun. Geochemical and Cosmochemical classification of elements and the basis there of. Differentiation of the Earth and resultant elements distribution.

Unit-II Laws of thermodynamics. Equations of State. Standard states. Enthalpy, entropy, heat capacity, changes in enthalpy and entropy with P and T, Gibbs free energy and equilibrium. Clapeyron equation. Simple thermodynamic calculations involving phase changes and equilibrium reactions. Equilibrium constant, geothermo-barometry.

Unit-III Aqueous geochemistry: Molarity and molality, solubility product and solubility, acids and bases, dissociation constant, pH, hydrolysis, ionic concentration. CO2-H2O interaction to form carbonic acid, dissolution of calcite, weathering reactions.

Unit-IV Trace elements: Raoult's and Hery's Law. Definition of trace elements. Properties of elements (volatiles, semi-volatiles, alkalis, alkaline earths, REE, HFS), Transition metals and noble metals. Trace element partitioning, factors governing values of partition coefficients (P,T, ionic size and charge, composition, crystal field effects).

Unit-V Nuclear structure and energies. Stability of nuclides. Radioactive decay schemes. Decay constant, half life, parent-daughter relations. Rb-Sr and Sm-Nd systematics and their use in geochemistry. Short-lived isotopes. Stable isotopes: processes of isotope fractionation, δ-notation for C, O, N and S isotopes, fractionation factor. O isotopes: fractionation in the hydrologic cycle, paleoclimatology. C and N isotopes fractionation in biological processes. Use of S isotopes in ore geology.

Text Books:

1. H. Y. McSween, S. M. Richardson and M. E. Uhle : ***Geochemistry: Pathways and Processes***. Second ed., 2004, Columbia University Press.
2. Robin Gill : 1988, ***Chemical Fundamentals of Geology***. Chapman and Hall.

Reference Books:

W. M. White : ***Geochemistry***. Retrievable from http://www.geo.cornell.edu/geology/classes/geo455.

Brian Mason : 1982, ***Principles of Geochemistry***. J. Wiley & Sons.

K. B. Krauskopf : 1979, ***Introduction to Geochemistry***. McGraw Hill.

D. K. Nordstrom and J. L. Munoz : 2006, ***Geochemical Thermodynamics***. Blackwell Scientific Publications.

Gunter Faure: (1986, 2004) ***Principles of Isotope Geology***. J. Wiley & Sons.

Hard Core Course **2 Credits**

EASC-314 GOLOGY LAB III - ORE PETROGRAPHY & GEOCHEMISTRY

Ore Petrography:

Study of physical properties of ore minerals and industrial minerals in hand specimen, and their identification. Study of textures and structures of ores in hand specimen.

Preparation of maps of major mining districts of India. Preparation of maps showing occurrence of various mineral deposits in India.

Geochemistry:

Wet-chemical analysis: Dissolution of minerals and rocks, Fusion using flux, analysis of Ca and Mg in limestone / dolomite, Na and K analysis using Flame photometer, Cl^- in water samples.
Calculation of mineral formula from the chemical analysis
Plotting of chemical analysis data in various binary and ternary diagrams.

EASC 321 Introduction to Geohydrology and Engineering Geology

Credits: 3

Geohydrology

1. Hydrologic cycle and its components. Origin, occurrence, accumulation and migration of water

   Introduction to Hydrological properties of rocks

2. Groundwater geology: Aquifer systems, Type and properties. Natural and Artificial Recharge of Ground Water

   Ground Water flow: Head distribution, Darcy's Law

3. Surface and Subsurface method of Ground water Exploration.

   Physical and Chemical Quality of Ground Water.Ground water provinces of India

Engineering Geology

4. Introduction to Role of Geology in civil construction.

   Stages of Geological site Investigations for selection of site for engineering structures: **Desk study:** Analysis of Remote sensing data, Geological maps, cross sections and written reports.**Subsurface site characterization:** Coring, logging, introduction to application of geophysical methods. Emphasis on pre-construction geological analysis to recognize potential hazards and problems.

5. Physical and Mechanical properties of rocks: Concepts of stress, strain, Mohr circle and failure theories. Strength, deformation, hydraulic aspects, geostresses, Weathering and Discontinuities in rock masses.

   Engineering classification of Rocks. Construction materials

Text Books:

1. K.R Karanth, 1989. Hydrogeology, Tata McGraw Hill
2. Bell, F.G. 1983. Fundamentals of engineering geology, Butterworths

Reference books:

1. D.K. Todd, 1980.Groundwater Hydrology, John Wiley and Sons.
2. C.F. Tolman, 1937.Groundwater, McGraw Hill, New York.
3. H.M. Raghunath, 1987Groundwater, Wiley Eastern. Calcutta.
4. Beavis, F.C. 1985. Engineering geology.
5. Krynine, D.P. Judd, W.P. 1957, Principles of Engineering Geology, McGraw Hill,
6. Davis, S.N. & De Wiest, R.J.N. 1966. Hydrogeology. John Wiley & Sons, New York.
7. Krynine, D.P. & Judd, W.R. 1957. Principles of engineering geology and geotechnique. McGraw Hill, New Yprk.
8. Goodman, R.E. 1980. Introduction to rock mechanics.
9. Schuster, R.L. & Krizek, R.J. 1978. Landslide analysis and control. National Academy of Science, Washington DC.

EASC 322 – Geomorphology and Remote Sensing

Credits: 2

Pre requisite: EASC 111 or Teacher's consent

Unit–1: Introduction: Fundamental concepts; Cycle of erosion; Base level.

Weathering: Review of factors influencing weathering

Physical: Expansion, crystal growth, thermal expansion, organic activity, colloidal plucking.

Chemical: Hydration, hydrolysis, oxidation, carbonation and solution.

Mass wasting: Conditions favouring mass wasting: lithology, stratigraphy, structure, topography, climate, organism etc.

Slow flowage: creep, solifluction

Rapid flowage: Earthflow, Mudflow, Debris avalanche Landslides: slump, slide, fall.

Unit-2: Depositional and erosional forms:

(a) Fluvial : Alluvium, alluvial fan, point bar, terraces, floodplain, natural levee, delta, watergap, gorge, canyon, valleys.

(b) Aeolian : Barchans, parabolic dune, transverse dune longitudinal dune loess. Deflation, ventifacts, yardang, pedestal rocks.

(c) Marine: Dune, beach, spit, bar, barrier, tombolo Abrasion platform, wave-cut terrace, stack, cave, natural arches-sea level changes

(d) Glacial: Mountain glaciation, Continental glaciation, moraines, esker, kames, kettle, drumlin. Cirque, hanging valley

Unit-3: Karst topography: Terra losa, lapies, sinkholes, blind valley, caverns, stalactites and stalagmites, natural bridge, tunnel.

Structural landforms: Faults, fault scarps, cuesta, hogback, horst, graben, folds, structure dome, inversion of topography.

Climate & landform: humid, sub-humid, semi-arid, arid; vegetation types; nature of weathering; climatic belts; morphogenetic regions.

Applied geomorphology: Groundwater investigations – aquifers – limestone regions; mineral deposits – placer, residual weathering, oxidized zones; engineering – construction materials, highway or railway routes.

Unit-4: Theory of remote sensing.

Introduction to the electromagnetic spectrum and its relationship to remote sensing in the ultraviolet, visible, infrared, and microwave region. Interaction of EMR with objects and Atmosphere.

Platforms and sensors. Aircraft, Satellite, Cameras, Films and Filters

Unit-5: Acquisition, processing, and interpretation of multispectral remote sensing data from aircraft and satellites, applied to geological, environmental, and land use studies and field verification.

Basic photogrammetry exercises like parallax measurements for height determination.

Text Books

1. W.D. Thornbury 1984, Principles of Geomorphology, First Willey Eastern Reprint, New Delhi.
2. Frank Press and Raymond Siever 1998, Earth (4th Edition) W.H. Freeman & Co., San Francisco.
3. Avery, T.E. and Berlin, G.L. 1992 Fundamentals of remote sensing and Airphoto intepretation. McMillion Publishing Co., New York.

Reference Books:

1. A.F. Pitty, 1971, Introduction to geomorphology, Methuen, London.
2. Drury, S.A. 1987. Image interpretation in Geology. Chapman and Hall.
3. Gupta, R.P. (1991) Remote Sensing Geology. Springer-Verlag.

EASC 323 – Field Training I- Geological Fieldwork and Mapping

Credit 3

Introduction to Topographic maps, identifying various topographic features like peaks, hills, valleys etc., and relating them to topographic maps / aerial photographs /satellite imageries. Basics of Global Positioning System (GPS).

Identification of various igneous, metamorphic and sedimentary rocks in the field and Identification of minerals and characterizing the rocks on the basis of mineralogy and texture

Location of contacts between different rock units, lithological mapping on topographic maps / aerial photographs /satellite imageries.

Identifying planar and linear structures in field: - folds, faults, joints, unconformity, lineations and foliations. Use of clinometer compass to measure various structural elements: Measurement of attitude of planar and linear structure: dip, strike, pitch, plunge and trend.

Collection and plotting of structural elements. Field training on reconstruction of surface and subsurface geological units from available exposures. (Total duration in field = 3 weeks)

EASC 324 Geology Lab IV - Remote Sensing and Geohydrology

Credits: 2

Aerial Remote Sensing

Study of stereoscopic view and elements of photo recognision. Airphoto interpretation for geological and geomorphological applications, interpretation of satellite images, basic photogrammetry exercises like parallax measurements for height determination, introduction to digital image processing and GIS application packages.

Geohydrology

Maps and numerical exercises. Problems on groundwater flow. Graphical representation of Ground water Quality.