# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

**IRINJALAKUDA, THRISSUR - PIN 680 125**

## DEGREE OF
## MASTER OF SCIENCE
## (CHOICE BASED CREDIT AND SEMESTER SYSTEM)

**UNDER THE**

## FACULTY OF SCIENCE

# SYLLABUS

**(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2014 – 15 ONWARDS)**

## BOARD OF STUDIES IN GEOLOGY (PG)

**IRINJALAKUDA, THRISSUR - PIN**
**680 125 KERALA, 673 635, INDIA**
**JULY, 2014**

# *CHRIST COLLEGE (AUTONOMOUS)*

## REGULATIONS, ELIGIBILITY, SCHEME AND SYLLABUS FOR MSc APPLIED GEOLOGY (CSS)
## (Effective from 2014 Admissions)

All the general rules and regulations laid down by the University of Calicut for PG (CSS) curriculum 2010 for affiliated colleges shall be applicable.

I. **ELIGIBILITY CRITERIA.** Those students who possess B.Sc Degree in Geology, Geology & Water Management as Core subject with Physics/Chemistry/Statistics/Remote Sensing &GIS/Mathematics as Complementaries are eligible for admission to this Programme.

II. **SCHEME OF EXAMINATIONS**

1. There shall be external university examination of 3 hour duration for each theory courses at the end of the each semester, to be conducted after the completion of 80 working days.
2. Each theory course shall have 4 credits.
3. Practical examinations shall be conducted by the university at the end of even semester
4. Each practical examination is of 4 hour duration and shall carry 4 credits each.
5. Project / dissertation evaluation and viva-voce shall be conducted at the end of the programme only. Practical examination, project / dissertation evaluation and viva voce shall be conducted by two external examinations.
6. Project / dissertation, combined field mapping and viva voce shall carry 4 credits each. Combined field mapping may be carried out at any time during the entire period of the programme.
7. Each theory question paper may contain 14 short answer types, of weight age 1, 7 short essays out of 10 of weight age 2. And 2 long essays out of 4, of weight age 4.

III. **EVALUATION AND GRADING**

1. The evaluation scheme for each course shall contain two parts (a) Internal evaluation and (b) external evaluation. 25% weight age shall be given to internal evaluation and the remaining 75% to external evaluation therefore the ratio and weight age between internal and external is 1: 3. Both internal and external evaluation shall be carried out using direct grading system.

***Internal evaluation:*** The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance. in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The weight age assigned to various components for internal evaluation is a follows.

**Components of Internal Evaluation**

| | Component | Weightage |
|---|---|---|
| A | Assignment | 1 |
| B | Seminar | 1 |
| C | Attendance | 1 |
| D | Test paper | 2 |

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal grade.
The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principal.

***External evaluation:*** The external Examination in theory courses is to be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination preferably in a Centralized Valuation Camp.
Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny on request and revaluation/scrutiny of answer scripts shall be done as per the existing rules prevailing in the University. Awarding of a higher grade after revaluation may be given only after a second revaluation.

**Direct Grading System**
1. Direct Grading System based on a 5 - point scale is used to evaluate the performance (External and Internal Examination of students)

**Direct Grading System**

| Letter Grade | Performance | Grade Point | Grade Range |
|---|---|---|---|
| A | Excellent | 4 | 3.50 to 4.00 |
| B | Very good | 3 | 2.50 to 3.49 |
| C | Good | 2 | 1.50 to 2.49 |
| D | Average | 1 | 0.50 to 1.49 |
| E | Poor | 0 | 0.00 to 0.49 |

2. Each course is evaluated by assigning a letter grade (A,B,C,D or E) to that course by the method of direct grading. The internal (weightage =1) and external weightage =3) components of a course are separately graded and then combined to get the grade of the course after taking into account of their weightage (See appendix).
3. An aggregate of C-grade (when external and internal put together) is required in each course for a pass and also for awarding the degree.
4. A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.
5. After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula as per the University norms.

# *CHRIST COLLEGE (AUTONOMOUS)*

## *MSc. Applied Geology - Course Structure, Scheme & Syllabus*

(Credit Semester System – 2010 Admission onwards)

I Semester

| Course | Course Code | Course Title | L | P | Exam Duration | Internal (%) | External (%) | Credits |
|---|---|---|---|---|---|---|---|---|
| Core | GEL 1C01 | Physical Geology & Geomorphology | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL1C02 | Structural Geology & Geotectonics | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL1C03 | Stratigraphy & Applied Palaeontology | 5 | | 3 hrs | 25 | 75 | **4** |
| *Practical | GEL1C04P | Geomorphology, Structural Geology, Applied palaeontology | | 10 | 4 hrs | 25 | 75 | **4** |
| **Total Credits** | | | | | | | | **16** |

II Semester

| Course | Course Code | Course Title | L | P | Exam Duration | Internal (%) | External (%) | Credits |
|---|---|---|---|---|---|---|---|---|
| Core | GEL 2C05 | Crystallography & Mineralogy | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL2C06 | Applied Geology & Marine Geology | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL2C07 | Hydrogeology | 5 | | 3 hrs | 25 | 75 | **4** |
| Practical | GEL2C08P | Crystallography, Mineralogy, Hydrogeology, and Applied Geology | | 10 | 4 hrs | 25 | 75 | **4** |
| **Total Credits** | | | | | | | | **16** |

L – Lecture hours; P – Practical Hours (Hour distribution in a week)

III Semester

| Course | Course Code | Course Title | L | P | Exam Duration | Internal (%) | External (%) | Credits |
|---|---|---|---|---|---|---|---|---|
| Core | GEL 3C09 | Exploration Geology | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL3C10 | Igneous and Metamorphic Petrology | 5 | | 3 hrs | 25 | 75 | **4** |
| Elective 1 | GEL3E01 Or GEL3E02 | Remote Sensing & Geographic Information System Climatology | 5 | | 3 hrs | 25 | 75 | **4** |
| *Practical | GEL3C11P | Exploration Geology, Igneous & Metamorphic Petrology | | 10 | 4 hrs | 25 | 75 | **4** |
| | | | | | | **Total Credits** | | **16** |

IV Semester

| Course | Course Code | Course Title | L | P | Exam Duration | Internal (%) | External (%) | Credits |
|---|---|---|---|---|---|---|---|---|
| Core | GEL4C12 | Economic Geology | 5 | | 3 hrs | 25 | 75 | **4** |
| Core | GEL4C13 | Geochemistry & Sedimentology | 5 | | 3 hrs | 25 | 75 | **4** |
| Elective 2 | GEL4E03 Or GEL4E04 | Environmental Geology Or Disaster Management | 5 | | 3 hrs | 25 | 75 | **4** |
| Practical | GEL4C14P | Economic Geology, Geochemistry, Sedimentology | | 5 | 4 hrs | 25 | 75 | **4** |
| Project / Dissertation | GEL4C15Pr | Project / Dissertation | | 5 | | 25 | 75 | **4** |
| Field Mapping | GEL4C16Pr | ** Combined Field Mapping | | | | 25 | 75 | **4** |
| Viva-Voce | GEL4C17V | Viva-Voce | | | | 25 | 75 | **4** |
| | | | | | | **Total Credits** | | **28** |
| | | | | | | **Total Credits for the whole Programme** | | **76** |

* Examination will be conducted at the end of even semesters.

** Field Mapping may be carried out anytime during the entire period of the programme

## *GEL1C01 PHYSICAL GEOLOGY AND GEOMORPHOLOGY*

**Unit I:**

Earth and the solar system, Meteorites and other extra-terrestrial materials, Planetary evolution of the earth. Heterogeneity of the earth's crust. Major tectonic features of the Oceanic and Continental crust.

The earth's magnetic field. Magnetic anomalies. Magnetic reversals. Heat within the earth. Geothermal gradient. Heat flow.

**Unit II:**

Gravity measurements. Positive and negative gravity anomalies. Geoid, spheroid; Isostasy

Basic concepts of seismology and internal structure of the earth. Physico-chemical and seismic properties of the earth's interior. Modern techniques for prediction of earthquakes.

**Unit III:**

Geomorphic principles and processes. Theory of uniformitarianism.Control of geomorphological features by geologic structures, lithology, climate and time. Geomorphologic cycles. Models of landscape evolution.

Streams-stream hydraulics- Drainage basin, Morphometric analysis of drainage basins. Fluvial-denudational and erosional landforms. Concept of rejuvenation and interruptions in the evolution of land.

Coastal Geomorphology. Landforms of wave erosion and deposition. Beach Profiling.

**Unit IV:**

Wetlands- Geological significance, classification and mode of formation. The Indian scenario - conservation and management in India. Backwaters (Kayals) of Kerala. Soils- formation, classification, soil profile, soils of Kerala. Geomorphology of Kerala- classification, relief features, geological Significance, rivers of Kerala. Geomorphic features of the Indian subcontinent.

**Unit V**:

Hill slopes- forms in relation to lithology and structural weakness in rocks; control and mass movement, modification by overland flow of hill slopes. Slope stability.

Applied Geomorphology : Application of Geomorphology in Civil Engineering, Hydrogeology, and Environmental Studies.

**References:**


1. Ahamed, E. Coastal Geomorphology of India. Orient Longman, New Delhi, 1972
2. Bloom, A., Geomorphology, CBS, New Delhi
3. Cox. A. Plate tectonics and geomagnetic reversals, Freeman, 1973
4. Eicher.L.D., Geologic Time, Prentice Hall, 1968
5. Fowler, C. M. R., The solid Earth; An introduction to global geophysics,Cambridge University Press, 1990
6. Hamilton, E. I., Applied geochronology, Academic Press, 1965
7. Hart M.G., Geomorphology-Pure and applied, Allen & Unwin, London. 1986
8. Holmes, A. Principles of Physical Geology, Ronald, London, 1972
9. Jacobs,J.A., Russel, R.D., and Wilson, J.T., Physics and Geology, WileyEastern.
10. King, C.A.M. Beaches and Coasts, Arnold, London, 1972
11. Leopold, L. Wolmen, C. and Miller J.P. Fluvial processes in Geomorphology, EPH Publishing House, New Delhi, 1976
12. Pethick, J., An introduction to coastal geomorphology, Arnold Heinman publishers, (India), New Delhi, 1984
13. Rice,R. J., Fundamentals of Geomorphology, ELBS, Longman,1990
14. Schumm, S .A. (Ed), Drainage Basin morphology- In Bench mark papers in Geology
15. Shartna, H. S.s Indian geomorphology, Concept Publishing .Co, New Delhi, 1990
16. Thombury, W.D. Principles of Geomorphology, Wiley, 1968
17. Windley, B.F., The evolving continents, John Wiley,& Sons

## *GEL1C02 STRUCTURAL GEOLOGY & GEOTECTONICS*

**Unit I:** Principles of geological mapping and map reading, projection diagrams. Stress-strain relationships of elastic, plastic and viscous materials. Measurement of strain in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Stress and Strain diagrams.

Folds - Geometric classification after Ramsay, Genetic classification after Donath and Parker. Plunging folds, cylindrical folds, minor folds and their uses in determining the major fold structure. Pumpelley's rule. Mechanics of folding. Superposed folding and interference patterns.

**Unit II:** Faults and fractures - Brittle and shear failure, Mohr circle, fault geometry and nomenclature. Features of fault planes and fragmental rocks produced by faulting. Deep fractures. Joints, analysis of fractures. Ductile shear zone. Stress and strain ellipsoids and their use in the study of faults and joints.

**Unit III**: Tectonites - classification, tectonic fabric. Foliation - axial plane foliation and its origin, fracture cleavages, crenulation cleavage and transposed foliation. Use of axial - plane foliation and fracture cleavages in the determination of major structures. Lineation: types, classification and origin.
Geologic bodies and scale and structural co-ordinates. Fundamentals of geometric analysis. Stereographic and equal area projections in structural geology and diagrams. Geometric analysis of folds and lineations. Concept of petrofabric, use of Universal stage in fabric studies, fabric symmetry.

**Unit IV**:

Continental drift — geological and geophysical evidence, mechanics, objections, present status.

Gravity and magnetic anomalies at Mid-ocean ridges, deep sea trenches, continental shield areas and mountain chains. Palaeomagnetism. Seafloor spreading.

**Unit V**:

Plate Tectonics. Different types of Plate margins. Island arcs, Oceanic islands and volcanic arcs. Orogeny and epeirogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

**References:**

1. Billings, M.P. Structural Geology, II Edition, Prentice Hall, 1974
2. Hills, E.S. Elements of Structural Geology, 1 Edn. Asia Publishing House, 1965
3. Hobbs, B.E. Means. W.D, and W i l l i a m P.F. An outline of Structural Geology, John Wiley, 1976
4. John. I Roberts, Introduction to Geological Maps and Structures, Pergamon Pres .
5. Ken MeClay The mapping of geological structures, Geological Society of London, John Wiley and Sons.
6. Philips, l'.C. Stereoscopic projection in Structural Geology, II Edn. Arnold, I960
7. Ragan, T.M. Structural Geology, I Edn. Wiley, 1963
8. Robert, J. Twiss and Eldridge, M. Moors, Structural Geology, W. H. Freeman and company, New York
9. Spencer, E. P. Introduction to the structure of the Earth, I Edn. McGraw Hill, 1969
10. Turner, F.J. and Weiss, L.E. Structural Analysis of Metamorphic Tectonics, IEdn. McGraw Hill, 1963
11. Whitten, E.H.T. Structural Geology of folded rocks, II Edn.

## *GEL1C03 STRATIGRAPHY & APPLIED PALEONTOLOGY*

**Unit I:** Stratigraphic principles and evolution. Contributions of Steno, Lehmann,Fushel, Werner, Hutton, Lyell and Smith. Stratigraphic procedures-surface and subsurface procedures.

Elements of Magnetostratigraphy, cyclostratigraphy, pedostratigraphy, chemostratigraphy and sequence stratigraphy.

Major geological events during the different periods of earth history. Mass extinction - Meteoric impact Theory - Volcanic eruption theory.

**Unit II:** Pre-Cambrian stratigraphy. Classification of Indian Pre-Cambrian with particular reference to Karanataka and Kerala. Greenstone belts and granulites of South India. Classification, lithology, ages, correlation of Sargur schist, Dharwar Supergroup, Cuddapah Supergroup and Vindhyan Supergroups.

Stratigraphic boundary problems with reference to Indian subcontinent - Vindhyan, Saline Series and Deccan Traps.

**Unit III**: Fossils and fossilisation Definition and morphology. Modes of preservation and geometry of fossils. Physico- chemical conditions of fossilisation. Significance of fossils in Chronostratigraphy, Biostraligraphy, correlation. Palaeogeography, Palaeoecology and Palaeoclimate.

Origin of life - Introduction - Extraterrestrial origin Terrestrial origin Early evolution of life - fossil records Modern concepts Theories of chemical basis of origin Miller's experiment - Theories of organic evolution.

**Unit IV:** Evolution histories of Dinosaurs, Equus, Elephus and Man.
Morphology, classification, evolutionary trends, palaeoecology and stratigraphic origin of the following groups - Brachiopoda, Pelecypoda, Cephalopoda, Trilobita, Graptolites and Stromatolites.

**Unit V**: Micropalaeontology - Scope and classification of microfossils. Techniques in collection, separation, preparation and preservation of microfossils including palynofossils. General morphology of spores and pollens - theirclassifications.
Classification, morphology, ecology, palaeoecology and stratigraphic importance of the following -Foraminifera, Ostracoda, Bryozoa and Conodonts.Application of microfossils **in** the petroleum exploration.

**References:**


1. Ager, D.V., Principles of Palaeontology, McGraw Hill, 1963
2. Arkell, W. J., Jurassic Geology of the World, Oliver and Boyd, 1960
3. Brouwer A., General Palaeontology. Olier and Boyd, 1967
4. Colebert H. Edwin, Evolution of the vertebrates, John Wiley and Sons, 1961
5. Cushman A. Joseph, Foraminifera, Harvvard University Press, 1959
6. Dalrymple,B.G ,and Lamphere, M. A., Potassium-Argon Dating, 1 Edn., Freeman, 1969
7. Dunbar, CO., and Rogers, J., Principles of Stratigraphy, Wiley, 1961
8. Easton, W.H. Invertebrate Palaeontology, Harper and Brother, I960
9. Eicher L.D., Geologic Time, Prentice Hall, 1968
11. Flint, R.F., Glacial and Pleistocene Geology, Wiley, 1961
12. G. H.B von Koenigswald, J.D. Ernies W.L Buning C. W. Wange (Editors), Evolutionary Trends in Foraminifera, Elsevier, 1963
13. Gignoux M., Stratigraphic Geology, Freeman, 1960
14. Glaesnewr, M.F. Principles of Micro Palaeontology, McGraw Hill, 1953
15. Gupta V.J., Cenozoic Stratigraphy of India, Hindustan Publishing House, 1975
16. Gupta V.J., Mesozoic Stratigraphy of India, Hindustan Publishing House, 1976
17. Gupta V.J., Precambrian Stratigraphy of India, Hindustan Publishing House, 1977
18. Hamilton, E. I., Applied Geochronoiogy, I Edn., Academic Press, 1965
19. John J. Daniel, Introduction to Microfossils, Harper and Brothers, 1956
20. Key and Colbert, Stratigraphy and Life History, Wiley, 1965
21. Krishnan, M.S., Geology of India and Burma, Higgin Bothams, 1968
22. Kruinbein, W.C., and Sloss L. D., Stratigraphy and Sedimentation, Freeman, 1963
23. Moore R.C., Lalicker C.G., Fisher A.G., Invertebrate Fossils, McGraw Hill, 1952
24. Moore R.C., An introduction to Historical Geology, McGraw Hill, 1958
25. Noa Version, Stratigraphic Principles of Palaeontology, Oxford University Press, 1952
26. Pichamuthu, C. S., Archaean Geology, Oxford I.B.B., 1985
27. Romer A.S., Vertebrate Palaeontology, Chicago University Press, 1966
28. Sarkar, S. N., Stratigraphy and Geochronoiogy of Peninsular India, I Edn., Dhanbad Publications, 1968
29. Shrock R.R., Berk Twenhofel W.H. Principles of Invertebrate Palaeontology, McGraw Hill, 1953
30. Swinnerton, H.H. Outlines of Palaeontology, Edward Arnold Ltd., 1961
31. Weller, Stratigraphic Principles and Practice, Harper and Row, 1959
32. Windley, B. F., The Evolving Continents, I Edn., John Wiley, 1977
33. Woods Henry, Invertebrate Palaeontology, Cambridge University Press, 1961
34. Zittel Karl A. Von, Text Book of Palaeontology, Parts I and II, McMillan, 1964.

## *GEL1C04P: Geomorphology, Structural Geology and Applied Paleontology*

**Geomorphology:**

Interpretation of toposheets and identification of geomorphic features, fluvial and coastal land forms. Calculation of surface area and slope. Study of drainage pattern and morphometric analysis.

**Structural Geology:**

Interpretation of geologic maps. Trigonometric, graphic and stereographic solutions to problems in structural geology. Geometric analysis of planar and linear structures. Fabric diagrams, Rose diagrams and histograms

**Applied Palaeontology:**

Separation of microfossils and preparation of slides of Ostracoda, Foraminifera and Bryozoa.

Identification and study of microfossils in slides, at least 10 Nos.

## *GEL 2C05 – CRYSTALLOGRAPHY & MINERALOGY*

**Unit I:** Crystallography-Crystalline state-Repetition theory. Translation periodicity of crystals. Basic rotational symmetries and possibility of simultaneous rotational symmetries in different directions of crystals-symmetrical plane and symmetrical lattices. Derivation of 32 crystal classes. Stereographic projection of crystals.

**Unit II:** Crystal notation- Schoenflies notation. Herman Mauguin symbols-comparison between Schoenflies and International notations. Calculation of crystal elements to test the knowledge of the application of tangent relation, anharmonic ratios, Napier's theorem and equation of the normal.
X-ray diffraction method- basic principles. X-ray diffractometer- Powder methods- Bragg 's law and its application- Calculation of cell dimensions-identification of minerals from X-ray diffraction patterns.

**Unit III:** Optical mineralogy. Refractive index. Isotropic and anisotropic minerals. Interference of light waves-passage of light through doubly refracting minerals. Birefringence. Plane polarized and cross polarized light. Orientations of nicol prisms of a Petrological Microscope. Pleochroism and scheme of pleochroism. Uniaxial & biaxial minerals; uniaxial & biaxial indicatrices. Orientationof indicatrices. Generation of interference colours. Finding the order of interference colours.

**Unit IV:** Optical accessories –construction and uses of Gypsum Plate, Mica Plate quartz wedge.
Conoscopic study – Formation of interference figures. Uniaxial and biaxial interference figures. Determination of the Optic sign of uniaxial and biaxial minerals.
Vibration directions and sign of elongation in minerals. Extinction and extinction angle. Determination of Optic axial angle (2V).Dispersion and types of dispersion.

**Unit V:** Isomorphism, Polymorphism and the types. Different types of bonding in minerals and their significance.

Solid solution and exsolution. Mineralogical expression of radioactivity- Metamictisation and pleochroic haloes.

Structure and classification of Silicates. Distinctive physical, chemical and optical characters of the following mineral groups: Olivine, garnet, aluminosilicates, pyroxenes, amphiboles, mica, clay minerals, feldspars, feldspathoids, zeolites and silica group.

**References:**


1. Burger, M.J., Elements of Crystallography, Wiley, 1963
2. De Jong,W.F., General Crystallography, Freeman ,1955
3. Bloss, D:F., Introduction to the methods of optical crystallography, Holt, Reinhart and Winston, 1961
4. Battey, M. H., Mineralogy for students, Oliver and Boyd, Edinburgh, 1972
5. Berry, L.G, Mason,B and Deitrich Mineralogy, 1976
6. Berry, L.G., Brian Mason, Mineralogy, Freeman, 1959
7. Dana, E. S., Text Book of Mineralogy Revised by Ford, Wiley, 1962
8. Deer, W. A., Howie, R. A., and Zussman, J., Rock forming minerals. Vol. 1-5,Longman, London, 1962
9. Hinnavvai, E. E., Methods in Chemical and Mineral Microscopy, Elsevier, 1966
10. Hurbut, C. S., Dana's Manual of Mineralogy, John Wiley, I8"[1] Edition, 1971
11. Kerr,P.F., Optical mineralogy, Me Graw Hill,1959.
12. Mason, B., Principles of geochemistry, Wiley Toppan, Tokyo, Japan
13. Mitra, S., Fundamentals of Optical, Spectroscopic and X-ray mineralogy,Wiley Eastern, Ltd, NewDelhi,
14. Naidu, P. R. J., Johansen, Optical Mineralogy, Allied Publishers, 1967
15. Naidu, P.R.J., Four axes.universal stage, Commercial printing and Publishing house, Madras, 1985
16. Philips, F. C, Introduction to Crystallography, Thomas Nelson, 1963
17. Philips, W.R., Mineral Optics-Principles and techniques,Freeman, 1971.
18. Putins. A., Introduction to mineral sciences. Cambridge University Press 1992
19. Sinkankas, J., Mineralogy, East West Edition, 1959
20. Tutton. V I:. II., Crystallography and Practical crystal Measurements. Vol. 1, Today and tomorrow. *.1965.* '
21. Velde. B (Ed).. ( Origin and mineralogy of clays, Springer-Verlag, 1995.
22. Wahlstrom, E E.. Optical Crystallography, Wiley. 1962
23. Wenk, H . R. (Ed), Electron microscope in mineralogy. Springer-Verlag,Newyork, 1976
24. Williams, K. L., Introduction to X-ray spectrometry, CBS Publishers and distributors, New Delhi-1987
25. Winchell, A.N., Elements of Optical mineralogy, Part I,Wiley,l951

## *GEL 2C06 – APPLIED GEOLOGY & MARINE GEOLOGY*

A. **Applied Geology:**

**Unit I:** Mining methods - Alluvial mining-river sand mining, Mining of beach placers, Clay mining, Coal mining, Seabed mining, Exploration of petroleum.

Fundamentals of ore dressing crushing, grinding, sizing, concentration by washing, scrubbing, jigging, tabling, floatation, magnetic and electrostatic separation.

**Unit II:** Engineering Geology - Role of Geology in civil engineering, engineering propertiesof rocks and soil, rock as building material, dimension and decorative stones, aggregates.

Dams classification, foundation, abutment and reservoir problems. Geologic aspects of dam investigation. Tunnels - classification, geologic factors in tunnels. Landslides - types, causes and preventions. Stability of slopes. Aseismic design of buildings influence of geologic conditions on foundations and design of buildings.

B. **Marine Geology**

**Unit III:** History of Marine geological studies-contribution of Challenger Expedition. Physical properties of sea water: distribution of temperature, pressure and density. Chemical properties of sea water-elements and dissolved gases present in sea water. Salinity and distribution of salinity.

**Unit IV:** Coastal processes: waves, currents and tides. Coastal geomorphology, classification of coasts; Coastal erosion. Coastal protection structures -seawalls, jetties, groins. Coastal Regulatory zone (CRZ) Continental margin: features of continental shelf, continental slope and continental rise.

**Unit V:** Sea bottom topography-Submarine canyons, trenches, volcanoes, mid-oceanic ridges and abyssal plains. Marine Mineral resources: Controlling factors and distribution. Eustatic changes of sea level: evidences and implications

Marine sediments: Distribution and classification. Plate tectonics in relation to origin of the ocean basins.

**References :**


1. Compton, R. R., Manual of Field Geology, John Wiley
2. Reedman, J. K, Techniques in Mineral Exploration, Allied Scientific Publishers
3. Arogyaswamy, R. N. F., Courses in Mining Geology, Oxford and IBH Pub. Co.
4. Fox, Engineering Geology
5. Peters, W. C, Exploration and Mining Geology, John Wiley
6. Krynine and Judd, Principle of Engineering Geology and Geotectonic, McGraw Hill. 1957
7. Rose, A. W., Hawkes, H. F., and Webb, J. S., Geochemistry in Mineral Exploration, Academic Press
8. John, L. Mero, Oceanic Mineral resources
9. Keith S.Stowe, Ocean Science. John Wiley and Sons
10. Kenneth, J.P., Marine Geology, Prentice Hall Inc., 1982
11. Moore. T. C, and Health. G. R., Sea-floor sampling techniques
8. Seibold, E., and Berger, W.H., The sea floor. Springer-Verlag, 1982
9. Shepard, F. P., Submarine Geology
10. Sverdrup, H. V., et al, The Ocean
11. Fading, D. H., palaeomagnetism, Chapman and Hall, London, 1983
12. Trask, P. D., Recent Marine sediments, Dover publications, 1939
13. Weisberg, J., and Parish, R, Introductory Oceanography. .McGraw Hill, 1974
14. William, L. Donn, Meteorology
19. Yasso, W. E., Oceanography

## *GEL 2C07 HYDROGEOLOGY*

**Unit I**. Origin of water: meteroic, juvenile, magmatic and sea waters, Hydrologic cycle: precipitation, runoff, infiltration and evapotranspiration, Hydrographs. Subsurface movement and vertical distribution of groundwater, Springs. Classification of aquifers. Concepts of drainage basin and groundwater basin. Hydrological properties of rocks – specific yield, specific retention, porosity, hydraulic conductivity, transmissivity, storage coefficient. Determination of permeability in laboratory and in field. Water table fluctuations – causative factors, concept of barometric and tidal efficiencies. Water table contour maps.

**Unit II** Theory of groundwater flow. Forces causing ground water movements. Darcy's Law and its applications. Unconfined, confined, steady, unsteady and radial flow conditions. Pump tests – methods, data analysis and interpretation for hydrogeologic boundaries. Evaluation of aquifer parameters using Thiem, Theis, Jacob and Walton methods.

**Unit III** Groundwater quality – physical and chemical properties of water. Quality criteria for different uses - domestic, irrigation and industrial. Graphical presentation of water quality data - Stiff diagram, Pie diagram, Piper's trilinear diagram nd USSL diagram. Problems of arsenic and fluoride in groundwater. Saline water intrusion in coastal and other aquifers. Ghyben-Herzberg relation. Prevention and control of saline water intrusion. Radioisotopes in hydrogeological studies.

**Unit IV.** Ground water exploration -Geologic and hydrogeologic methods. Surface geophysical methods –electrical resistivity method: Wenner and Schlumberger configurations for vertical electrical sounding. Subsurface geophysical methods – well logging for delineation of aquifers. Remote sensing for groundwater exploration - hydrogeomorphic mapping of the terrain using different images of different satellite missions, lineament mapping, shallow groundwater potential zone mapping using satellite images.

**Unit V.** Types of wells, drilling methods, construction, design, development and maintenance of wells, specific capacity and its determination.

Groundwater problems related to foundation work, mining, canals and tunnels. Problems of over exploitation and groundwater mining. Groundwater development in urban areas and rain water harvesting, Artificial recharge methods.

Groundwater provinces of India.

**References:**


1. Bouwer,H Groundwater Hydrology. 1978
2. Davies and De Wiest, Hydrogeology, John Wiley and Sons, 1966
3. Dominico, P. A.. Concepts and models in Groundwater Hydrogeology, McGrawHill
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8. Todd, D. K., Groundwater Hydrology, John Wiley and Sons, 1980
9. Tolman, C. F., Groundwater, McGraw Hill
10. Walton, W. C, Groundwater Resource Evaluation, McGraw Hill, 1970
11. Freeze and Cherry – Groundwater.


## *GEL2C08P: Crystallography, Mineralogy, Hydrogeology, and Applied Geology*

**Crystallography:**

Spherical projection of Cube, Octahedron and Dodecahedron. Stereographic projection of holohedral classes of all the systems, pyritohedral, tetrahedral, plagiohcdral classes of Isometric system and Rhombohedral classes of Hexagonal system. Gnomonic projections of the normal class of Isometric, Tetragonal, Hexagonal and Orthorhombic systems. Calculations of Axial ratios, Zone symbols, Napier's rule, Laws of anharmonic ratio.

**Mineralogy:**

Identification of mineral specimens based on physical properties. Determination of the following optical characters by classical methods

1. Order of interference colour
2. Sign of elongation
3. Birefringence
4. Scheme of pleochroism
5. Optic orientation
6. Determination of the vibration directions ofpolariser and analyzer
7. Extinction and extinction angle determination
8. Optic sign
9. Refractive index by Becke line method
10. Identification of thin sections of important rock forming minerals

**Hydrogeology:**

Preparation and interpretation of water table contour maps. Problems on Porosity, permeability, void ratio and Darcy's Law. Computation of aquifer parameters from pump test data. Graphical representation of hydro chemical data- Piper trilinear diagram,USSL Diagram, Stiffs polygon. Calculation of various parameters based on chemical data, electrical resistivity survey and interpretation of data.

**Applied** Geology:

Engineering properties ofrocks.

## *GEL 3C09 – EXPLORATION GEOLOGY*

**Unit I:** Methods of surface and subsurface exploration. Prospecting for economic minerals. Drilling and its types. Different methods of sampling and assaying. Methods of ore reserve estimation.

**Unit II:** Geochemical exploration techniques. Mobility of elements, pathfinder elements, threshold values and geochemical anomalies. Mode of occurrence of trace elements. Primary dispersion pattern of deep-seated origin. Diffusion and leakage anomalies.

Geochemical surveys, principles and methods of sampling. Anomalies in ground and surface waters and sediments. Biochemical anomalies. Geobotanical survey techniques. Geobotanical indicators.

**Unit III:** Geophysical exploration - Principles, scope, chief methods and their application.

Electrical methods - principles, instruments used. Self potential methods, resistivity method Application in ground waterexploration.

**Unit IV:** Gravity methods - Density and rock types, correlation of gravity data, regional and local anomalies.Sample interpretation, instrument used -gravimeter. Magnetic methods - field procedure, magnetometer, interpretation of magnetic data, correlations and applications. Principles of air borne survey.

Seismic method- Seismic waves, travel velocity in various geological formations – Principles Field operations. Refraction and reflection survey - correction of seismic data - methods if interpretation - determination of attitude and depth of formation. Various types of shooting. Seismic instruments and records.

**Unit V:** Radiometric methods principles of radioactivity, methods, types of counters: G.M. counters and Scintilometers. Field methods and interpretations.

Geophysical well logging Electrical, radiometric, sonic and thermal logging of boreholes.

**References :**

Compton.R.R., Manual of Field Geology, John Wiley

1. Dobrin M.B, Introduction to Geophysical Prospecting, Pergamon Press
3. Elements of Prospecting and Exploration, Kalyan Publishers
4. Ginzburg, 1. I., Principles ofGeochefnical prospecting, Pergamon Press
5. Griflithis, D. 11., and Kind, R. F., Applied Geophysics for Geologists andEngineers, Pergamon Press
6. Kovalarkim, Biochemical exploration for mineral deposits Co-Xinian Press
7. Lahee, F. H., Field Geology, Mc Graw Hill
8. Low, G.W., Geological Field Methods, Harper and brothers
9. Malyyuga,D.F.,Biochemical methods of prospecting, Consultants Bureau,NewYork
10. Reedman, J. H., Techniques in Mineral Exploration, Allied Scientific Publishers
11. Sinha, R. K.., and Sharma, N. L, Mineral Economics, Oxford and I.B.H. – Publishers

## *GEL 3C10 – IGNEOUS AND METAMORPHIC PETROLOGY*

A. **Igneous Petrology**

**Unit I:** Bowen's reaction principle and reaction series. Major, minor, trace and rare earth element geochemistry of igneous rocks. Significance of isotopic studies in the petrogenesis of igneous rocks.
Igneous process and diversity in igneous rocks. Compositional variation in magmas.

Genetic significance of the textures and structures of the igneous rocks.
Phase rule and its application in the study of silicate systems - phase diagrams, primary phase diagrams and liquidus projections.

**Unit II:**

Equilibrium crystallization and melting paths in igneous systems.

Phase diagrams- Unary, binary, ternary and quaternary diagrams. Study of the course of crystallization of the following chemical systems:

Binary systems : Fo-Fa . Ab-An , Di-An , Di-Ab and Fo –Si
Ternary systems:
Forsterite- Diopside – Silica, Diopside - Anorthite - Silica
Diopside - Anorthite – Albite, Albite – Anorthite - Orthoclase
$MgO - Al_2O_3 - SiO_2$.

**Unit III**:

Classification of igneous rocks- Shand , Streckeisen and CIPW Mode and Norm . Variation diagrams . Petrogeny's residua system. Differentiation index.

Petrography and petrogenesis of Kimberlites and Carbonatite:, Anorthosites, Basalts, Ultramafites and Ophiolites, Monomineralic rocks, Alkaline rocks, Pegmatites, Lamprophyres, Granites.

**B. Metamorphic Petrology**

**Unit IV:** Concept of Metamorphic zones. Concept of Metamorphic Grade, Concept of metamorphic facies series, Concept of metamorphic grade.

Solid-solid reactions, Genetic significance of textures and structures of metamorphism. Application of thermodynamics in metamorphic rock formation. Paired metamorphic Belts and plate tectonics.

Polymetamorphism, Retrograde metamorphism Metasomatism.Granitisation. Metamorphic reactions in carbonate rocks, basic rocks, argillaceous rocks and ultramafic rocks.-

**Unit V:** Mineral paragenesis- Graphical representation of metamorphic mineral paragenesis, composition plotting ACF, AKF, AFM. Diagrams.

Petrography and petrogenesis of Migmatites, Charnockites, Granulites, Marble, amphibolites, Schist, Gneiss, Slate and phyllite, Eclogite

**References :**


1. Barth, T; F. W., Theoretical Petrology, Wiley, I Edn., Dover Publication, 1962
2. Bowen, N. D., Evolution of Igneous Rocks, I Edn., Dover Publication, 1956
3. Carmichael, Ian, S. E., Turner. F. J., Vcrhoogen, J., Igneous Petrology, McGraw Hill, 1971
4. Ehlers. E.G. The interpretation of Geological Phase Diagrams, Freeman, 1972
5. Hans Ramberg, The Origin of Metamorphic and Metasomatic Rocks, Chicago University Press. 1962
6. Hyndman, E. D , Petrology of Igneous and Metamorphic rocks, McGraw Hill, 1972
7. Johansson, A Descriptive Petrography of Igneous rocks, Vol. 1,11, 111, IV, 1957
8. Johansson, Manual of Petrographic methods, McGraw Hill, 1952
9. Mason, B. D., Nelson, G. W., Lunar Rocks, Wiley, 1970
10. Miyashiro, A., Metamorphism and Metamorphic belts, Allan and Unwin, 1972
11. Phillips, Principles of Igneous and Metamorphic Petrology, Prentice Hall, 1990
12. Robert, F. Muller, and Surendra K. Saxena, Chemical Petrology, Springer Verlag, 1977
13. Turner, F. J., Metamorphic Petrology, McGraw Hill, 1968
14. Tyrrel, G. W., Principles of Petrology, Methuen, 1963
15. Vernon R. H., Metamorphic Processes, Murby, 1976
16. Wahlstrom, E., Theoretical Igneous Petrology, Wiley, 1961
17. William, H., Turner, E. J., Gilbert, M. C, Petrology, Freeman, 1954
18. Winkler, H.C.F., Petrogenesis of Metamorphic rocks. III Edn,, Springer Verlag, 1974


## *GEL3E01- REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM*

**Unit I:** Brief History and the developments in Aerial photography.Geometry and type of aerial photographs. Scale of photographs. Type of aerial cameras,films and filters. Multiband photography. Tilt and height displacement. Vertical exaggeration.
Stereoscopy. Mosaics. Elements of photo interpretation: tone, texture, pattern, drainage and lineaments. Use of Aerial photographs in photogrammetry, land use, forestry, agriculture, environmental studies,
**Unit II:** Principles of Satellite Remote Sensing. Electromagnetic spectrum.Platforms and sensors. Space-borne platforms. Sun synchronous and geosynchronous satellites. Description of payloads. Land coverage capability- detector arrays- sensitivity. Resolution concepts- Spatial, Spectral, Radiometric and Temporal resolution. Multi Spectral Scanners (MSS). Spectral signatures.
**Unit III**: Principles and applications of thermal detectors. Thermal Infra Red scanners- airborne and space borne TIR sensors. Airborne and satellite borne RADAR. SLAR.
Application of remote sensing data in i) geomorphologic mapping, ii)Fluvial, coastal, deltaic landforms**,** iii) lineaments iv) lithology v) ground water exploration**,** vi) land use /land cover mapping.Status of remote sensing studies in India.
**Unit IV:** Fundamentals of GIS. Components of GIS. Digitization of information and encoding. Vector and Raster formats Elements of topology. Concept of Thematic maps. Map Registration, topology creation, transformation, and projection
**Unit V:**. Creating Maps using any one of the GIS software – Arc View / ArcGIS / Map Info. Application of GIS in various disciplines Geology, Urban Planning, Forestry, Hydrology, and Agriculture.

**References :**


1. Avery, T.E. Interpretation of aerial photographs, Burges Publishing Co 1968 Burrow, P. A. and Mc Donnel, R. A. Principles of Geographic Information Systems, Oxford Publishers, 1998
2. Clark, K.C. Getting started with Geographic Information System, Prentice Hall,1990
3. Demer**,** M.N. Fundamentals of GIS, John Wiley & Sons, 2000.
4. Dickinson, A. E. Maps and Air photographs, Edward Arnold, 1979
5. Drury, S. A. Image interpretation in Geology; Chapman and Hall, London, 1993
6. ESRI. Understanding Geographic Information System. The Arc lnfo Method, Wiley Publishers
7. Estes, J.W. and Leslie W. Senger, Remote Sensing - Techniques for Environmental analysis, Hamilton Publishing Co., 1974
8. Heywood, 1. Cornelius, S. and Canver, S. An introduction to Geographical Information System, Pearson Education Asia Pvt. Ltd. 1993
9. Jensen, J. R. Remote sensing of the environment - An Earth Resource Perspective, Cambridge University Press, 2000
10. Matter, P.M. Computer processing of remotely sensed images, second edition,Wiley Eastern, 1999
11. Peter A. Burrough and Ruchael, A. McDonnell, Principles of Geographical Information System, Oxford Publishers
12. Siegal, D.S., Gillespie A.R. Remote Sensing in geology, John Wiley, 1980
13. Star, J. Ester, J. Geographic Information System - An introduction, Prentice Hall, 1990
14. Thomas M. Lilesand, and Ralph W. Keiferr. Remote Sensing and Image Interpretation, John Wiley and Sons 1979.


## *GEL3E02- CLIMATOLOGY*

**Unit I:** Structure and composition of the atmosphere – Global warming
**Unit II:** Climatic zones and types- main climatic zones, classification- Climatic groups and their subdivisions. Geographical distribution of the climatic types – Koppen's and Thornthwaite's classification of climate.
**Unit III:** Cloud formation and precipitation processes – Air sea interaction on different space and time scales. Insolation and heat budget. Radiation balance. General circulation of the atmosphere and ocean.
**Unit IV:** Climate and sea level changes on different time space. Coupled ocean atmosphere system. EL Nino southern oscillation (ENSO), LaNino
**Unit V:** General weather systems of India, Monsoon system, Cyclone and anticyclone, Jet stream. Distribution of precipitation over India. Western disturbances and severe local convective **systems**.

**References:**


1. Berneard Hauruitz and James, M. Austin, Climatology, Mc Graw Hill publications, Newyork & London.
2. D.S. Lal., Climatology
3. Austin Miller. A., Climatology
4. B.S. Negi., Climatology and oceanography.

## *GEL3C11P- Exploration Geology, Igneous & Metamorphic Petrology*

**Exploration Geology:**

Problems in averaging assays. Estimation of ore reserves - Cut off grade

**Igneous and Metamorphic Petrology:**

Preparation of thin sections of igneous and metamorphic rock samples. (2 nos. each). Petrography of igneous and metamorphic rocks. Textures and structures of igneous and metamorphic rocks and their genetic significance with neat sketches. Determination of modal composition, Calculation of norm (25 exercises). Niggli values. Variation diagrams Harker, Larsen, Niggli. Calculation of Differentiation index. Peacock alkali-lime index. Use of triangular diagram in the classification of igneous rocks. Use of triangular diagram in the classification of igneous rocks.Identification of metamorphic mineral paragenesis in hand specimens and thin sections and arranging them according to the intensity of metamorphism. Graphical representation of metamorphic mineral parageneses. ACF and AKF diagrams. AFM diagrams. Construction of phase diagrams based on experimental data of the following systems- Albite-anorthite, Forsterite-fayalite, Diopside- anorthite, Diopside - albite, Forsterite -silica.

## *GEL4C12- ECONOMIC GEOLOGY*

**Unit 1:** Significance of minerals in national economy. Tenor, grade and specification for minerals. India's status in mineral production. Strategic, critical an essential minerals. National mineral policy.
Ore microscope polishing and mounting of ores. Physical and optical properties of important ore minerals.
**Unit II;** Classification of ore deposits - Lindgren and Bateman classifications. Controls of ore localization, rnagmatic epochs and provinces. Micro textures of ore, Paragenesis and zoning. Geologic thermometry, wall rock alterations.

**Unit III:** Ores in igneous rocks - ores of mafic and ultramafic associations - Ultra mafic-mafic chromium platinoid associations - form, distribution, setting, constitution and origin. Ores of felsic associations - the carbonatite associations - form, distribution, setting, constitution and origin. Anorthosite - Fe- Titanium oxide association, distribution, form, setting, constitution and origin.

**Unit IV:** Strata bound and stratiform ore deposits - distribution, form, setting and origin. Ore deposits related to plate boundaries . Ore deposits of metamorphic affiliations.

**Unit V:** Coal Geology classification, petrography, genesis and periods of coal formation Distribution of coal fields of India, Neyveli Lignite Field.
Petroleum Geology Introduction- physical properties and chemical composition, occurrence and origin. Source materials and source locations -conversion to petroleum. Reservoir rocks classification of reservoir traps -general, structural, stratigraphic, salt domes. Distribution of oil fields in India. A brief introduction to gas hydrates.

**References :**


1. Anthony, M. Evans, An introduction to Ore Geology, Blackwell Scientific Publication, 1980
2. Ashok Mukherji, Ore Genesis - A Holistic approach, Prentice Hall, Calcutta
3. Bateman A. M., Economic Mineral Deposits, Wiley, 1962
4. Brian Mason, Principles of Geochemistry, Wiley, 1966
5. Brown, J. C, and Dey, A. K., India's Mineral Wealth, Oxford, 1936
6. Cameron, E. N., Ore Microscopy, Wiley, 1961
8. Edwards, A. B., Textures of the Ore Minerals, Aus. Inst. Min. and Met. 1960
9. Jenson and A. M. Bateman, Economic Mineral deposits, 111 Edn. John Wiley
10. Krauskopf, K., Introduction to Geochemistry, McGraw Hill, 1967
11. Levorson, A. I., Geology of Petroleum, McGraw Hill, 1958
12. Lindgren, Mineral Deposits, McGraw Hill, 1933
13. Nininger, R. D., Minerals for atomic energy, von Nostrand, 1956
14. Park C. G., and Mac Diarmid, R. A. Ore Deposits, Freeman, 1964
15. Rankama, K., and Sahama, T. G., Geochemistry, Chicago Uty. Press, 1949
16. Stanton, R. K., Ore Petrology, McGraw Hill, 1972
17. Tissot, B. P., and Welta, D. H., Petroleum formation and occurrence, Springer Verlag, 1978
18. Van Krcsalon, D.. Coal, Elsevier, 1961


## *GEL4C13- GEOCHEMISTRY AND SEDIMENTOLOGY*

**A. Geochemistry.**

**Unit I :** Origin and cosmic abundance of elements. Geochemical constitution of earth's crust, mantle, core and meteorites. Geochemical classification and distribution of elements.Primary differentiation of elements. Geochemical cycle.

Elementary crystal chemistry and thermodynamics. Laws of thermodynamics Enthalpy.Fntropy,Heat capacty , Free energy , and Fugacity Gibbs phase rule and its applications to mineralogical systems. Eh-pH in sedimentary environments.

**Unit II:** Isotope geology . Application of isotopes: Stable isotopes -Carbon, Oxygen, Hydrogen and Sulphur. Geochronology: Introduction to radioactivity, decay schemes, growth of daughter elements, fundamentals of dating methods. Experimental procedures and technical problems.Unstable isotopes- U-Th-Pb, K-Ar, Rb-Sr. Sm-Nd, C-14 and fission track methods in dating geological materials and events

Analytical techniques: Methods based on Flame photometer, Spectrophotometer, Atomic Absorption Spectrometer, Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES), Methods based on magnetic properties

**B. Sedimentology**

**Unit III:** Origin of sediments and sedimentary rocks: weathering, transportation, deposition, lithification and diagenesis. Elements of hydraulics. Provenance of sediments.Grain size classification, grade scale and sediment classes.Grain size analysis-sieving and pipette analysis, graphic representation of size analysis data; statistical parameters and their geological significance.

**Unit IV** Textures of sedimentary rocks: clastic and non-clastic textures,Textural maturity. Structures of

sedimentary rocks and their significance: primary and secondary structures.
Classification of sedimentary rocks: Rudaceous, arenaceous argillaceous and calcareous rocks.Chemistry, Mineralogy and petrograph) of non-clastic Sediments: Siliceous, Phosphatic, carbonaceous and evaporate deposits.

**Unit V**: Heavy minerals and their significance. Heavy mineral separation and identification; study of grain mounts. Mineralogical maturity. Depositional environments - Terrestrial, marine and transitional environments. Physico-chemical controls of sedimentation Tectonic control on sedimentation; Plate tectonics in relation to evolution of sedimentary basins. Sedimentary basins of India.

**References :**


1.Brian Mason, Principles of Geochemistry, Wiley 1966.
2.Brownlow, A.N., Geochemistry, Prentice Mall, 1975.
3.Gunter Faure, Principles of Isotope Geology, John Wiley and Sons, 1977
4.Konrad B. Krauskopf, Introduction to Geochemistry, McGraw Hill, 1979
5.Krauskof E.A. Introduction to Geochemistry, .McGraw Hill, 1967.
6. Paul Henderson, Inorganic Geochemistry, Pergamon Press 1982.
7. Rankama K,Progress in Isotopic Geology, Intcrscience , 1963.
8. Rankama,K and Sahama, T.H.C., Geochemistry. University of Chicago Press. 1950.
9. Blatt, R, Middleton, G., and Murray, R., Origin of Sedimentary Rocks, Prentice Hall, 1980
10. Carver, R. E. (Ed.), Procedures in Sedimentary Petrology, Interscience, 1971.
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12. Dickinson, W. R., and H. Yarborough, Plate tectonics and Hydrocarbon accumulation
13 Emery, K. O. and B. J. Skinner, Mineral deposits of the Deep Ocean Floor
14. Folk, R. I., Petrology of Sedimentary Rocks, Hemphill's University Station, Texas, 1968
15. Friedman, and Sanders, Principles of Sedimentology, John Wiley and sons, NewYork
16. Hatch and Rastall, Petrology of Sedimentary rocks, Thomas Murby & Co
17. Prothero and schwab, Sedimentary Geology, W.I 1. Freeman & Co.
18.Reineck and Singh, Depositional sedimentary environment Springer Verlag
19.Roy Thompson and Frank Oldfield, Environmental Magnetism, Allen and Unwin, London,1986
20. Pettijohn, I J.. Sedimentary Rocks, I larper and Row Pub. New Delhi, 1975
21. Peter, K. Weyl, Oceanography An introduction to the marine environment
22. Pettijohn, F. J., Potter, T. !•., Siever, R., Sand and Sandstone, Springer
23.Milner, Sedimentary Petrography, Vol. I and 11; George Allen and Unwin
24. Krumbein and Pettijohn, Manual of Sedimentary petrography
25. Krumbein and Sloss, Stratigraphy and sedimentation, W.H. Freeman & Co.
26. Krumbein, W. C, and Pettijohn, E. J , Manual of Sedimentary Rocks, Appleton Centuary, Co., 1938
27. Sengupta, Introduction to Sedimentology, Oxford & 1BH
28. Solley, R. C, Ancient Sedimentary environments, Cornwall, University Press, 1972
29.Tucker, Sedimentary Petrology: An introduction. John Willey & Sons, New York, 1981
29. Wenhofel, Principles of Sedimentation, Me Graw Hill Book Co.

## *GEL4E03- ENVIRONMENTAL GEOLOGY*

**Unit I:** The physical environment **of** earth. Natural resources: conservation and preservation. Concept of sustainable development. Geologists' role in environmental management and planning. Interaction between human and Nature. Disaster management. Environment impact Assessment (EIA), Environmental mapping.

**Unit II:** Geological processes and hazards created by human. Environmental consequences of natural hazards like earthquakes, landslides arid volcanic activity.. Conservation and land use planning. Urban development. Soil conservation. Wastes created by human activity such as mining and industrial activities, Pollution studies and its significance. Air and Water pollution.

**Unit III:** Water pollution: Sources, problems originating above the land surface. Disposal of wastes, dumps, sewages, problems originating above the water table - waste disposal, agricultural drainage, subsurface storage, mines, nuclear implosion.

**Unit IV:** Controls of ground **water** pollution - collection and treatment, detoxification and biodegradation, health hazards due to ground water pollution-heavy metals, radioactive material. Microbes, BOD and COD

**Unit V:** Coastal environments: -Distribution, variation and interaction of Physico - chemical and geological parameters on near shore and free shore ecosystems. Mangroves Marine pollution; Causative factors- land based sources- marine based sources- types of pollution- oil spills- processes of oil water interface- effects on ecosystems.

**References :**


1. Donald R Coates Ed. Environmental Geomorphology & Environmental Geoscience.Wiley International
2. Donald R Coates, 1981. Environmental Geology. John Wiley and sons
3. Eennis Barlin 1980 Earthquakes and Urban Environment V.1,2&3 CRC Press
4. Peter T Elavan, l970. Environmental Geology, Harper& Row

## *GEL4E04-- - DISASTER MANAGEMENT*

Unit I Management: Comprehensive Disaster Management Plan and it's Elements, Disaster Management Act-2005, and its Institutional Framework- Policy and Administrative frame work for Disaster Management.

**Unit II**

Understanding Natural Disasters: Earth Quake, Landslides, Avalanches, Volcanic eruptions. Heat and Cold waves, Coastal Disasters, Cyclone, Flood, Drought ,Tsunami.

**Unit III**

Understanding Man-made Disasters: Nuclear Disasters, Chemical Disasters, Biological Disasters, Building fire, Coal fire, Forest fire and Oil fire, Rail accident, Road accidents, Air accidents, Sea accidents, Dams and Dam bursts, Air pollution, Water pollution, Industrial pollution, Climate change: Global warming, sea level rise, Ozone Depletion.

**Unit IV**

Hazard, Risk and Vulnerability: Concept and Elements, Risk Reduction Disaster Management.: Prevention, Preparedness and Mitigation.. Disaster Preparedness Plan, Role of Information, Education, Communication and Training, Role of various Agencies in Disaster Response, NGO's, Armed Forces, Police and other Forces.

**Unit V**

Potential hazards in Kerala with special reference to landslides and coastal erosion during the monsoons.

Manmade drought during summer, saline water intrusion along the coastal aquifers – mitigation measures.

Cyclone, drought and flood in various parts of India – frequency of occurrence, vulnerable areas-reasons.

**References**


1. Abbot.P.C (2002): Natural Disaster, McGraw Hill Publications New Delhi
2. Coates.D.R (1985) Geology & Society – Chapman & Hall Publishers New Delhi
3. Davis et.al (1976) Environmental Geosciences – Wiley Eastern
4. Howard A.D & Irwin Remson (1978) – Geology in Environmental Planning –McGraw Hill Publishers
5. Keller E.A (1976) – Environmental Geology – Charles E Merril publishers – New Jersey
6. Lindgren.L(1986) Environmental Geology – Prentice Hall Publication- New Jersey
7. Strahler N & Strahler A.H ( 1973) – Environmental Geosciences Wiley eastern publishers


Introduction- Hazard and Disaster: Definition and Terminologies, Classification. Understanding Disaster

## *GEL4C14P- ECONOMIC GEOLOGY, GEOCHEMISTRY & SEDIMENTOLOGY*

**Economic Geology**:

Identification of important ore minerals. Collection and display of data on production, consumption and export of important minerals. Identification of ore minerals under ore microscope. Genetic significance of important ore minerals.

**Geochemistry:**

Mineralogical calculations using chemical analysis data - simple minerals olivine, feldspar, feldspathoids, pyroxenes, hornblende, garnet. Determination of pH of groundwater samples Determination of Na and K using flame photometer.

**Sedimentology:**

Sieve analysis- plotting of sieve analysis data- histogram, Folk and Ward, Trask methods. Measurement and calculation of shape parameters, plotting and interpretation of these data Separation of light and heavy minerals. Preparation of grain mounts. Study of grain mounts of Magnetite, Ilmenite, Monazite, Rutile, Garnet, Sillimanite, Zircon, Quartz, Leucoxene and Hornblende. Microscopic and megascopic study of sedimentary rocks.