

**M.Sc. GEOLOGY**  
**(CBS) (FIVE YEAR INTEGRATED PROGRAMME)**

**REGULATIONS AND SYLLABUS**  
**REGULATIONS**

(w.e.f. 2014-2015)

**REGULATIONS**

**Eligibility**

Candidates for admission to the First year of the Five year Integrated M.Sc., Applied Geology degree programme shall be required to have passed in higher Secondary Course examinations (HSC) or equivalent thereto under academic stream in any science group.

**Master Programme**

A Master's programme consists of a set of Core courses and Common courses on languages, Computer application, Civics, Health & Environment and Soft skill.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the respective faculties.

Common courses suggested by the respective departments may be distributed in the first four semesters.

A course is divided into five units to enable the students to achieve modular and progressive learning.

**Semesters**

An Academic year is divided into two semesters, Odd semester and Even semester. The normal semester periods are:

Odd semester: July to November (90 working days)

Even semester: December to April (90 working days)

**Credit**

The term credit is used to describe the quantum of syllabus for various programmes in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for a Five year Integrated Master's Programme shall be 225.

The core courses shall carry 155 credits, Common courses shall carry 10 credits, Allied courses shall carry 20 credits, Language courses shall carry 24 credits and the optional courses shall carry 16 credits.

### **Courses**

A course carrying one credit for lectures, will have instruction of one hour per week during the semester, if four hours of lecture is necessary in each week for that course then 4 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lecture tutorials/laboratory work and other form of learning in a 15 week schedule:

- i) One credit for **each** lecture **hour** per week.
- ii) One credit for every **two or three hours** of laboratory or practical work per week as per the requirement of department concerned.

### **Grading System**

The term Grading System indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

### **Duration**

The duration for completion of a Five year Integrated Master's Programme in any subject is **Ten** semesters.

### **Structure and Programme**

The Five year Integrated Master's Programme will consist of:

- i) Core courses and Common courses which are compulsory for all students.
- ii) Optional courses which students can choose amongst the courses offered by the Departments of Science faculty as well as by the Departments of other faculties.  
(Arts, Education and Indian Language)

### **Attendance**

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

Each student should earn 80% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the End-semester examination.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a condonation fee and such exemptions should not under any circumstance be granted for attendance below 70%.

### **Examinations**

The internal assessment for each theory course carries 25% marks and practical course 40% of marks which is based on two internal assessment tests with assessment tools such as seminar and assignment. The pattern of question paper will be decided by the respective faculty. **The tests are compulsory.**

For internal assessment evaluation, the break-up marks shall be as follows:

<b>THEORY</b>	<b>MARKS</b>	<b>PRACTICAL</b>	<b>MARKS</b>
Test-I	10	Test-I	15
Test-II	10	Test-II	15
Assignment	5	Record	10
<b>Total</b>	<b>25</b>	<b>Total</b>	<b>40</b>

There will be one End Semester Examination (75% marks) of 3 hours duration for each Theory course and an End semester examination (60%) to each Practical courses. The pattern of question paper will be decided by the respective faculty.

### **Evaluation**

The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum total performance in each semester will be rated by GPA while the continuous performance in Core, Allied and Optional courses will be marked by (CGPA).

### **Marks and Grading**

The student cannot repeat the internal assessment test I and internal assessment test II. However, if for any compulsive reason, the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

A student has to secure 50% minimum in the End Semester Examination.

The student who has not secured minimum of 50% of marks (Internal assessment mark plus End semester examination) in a course shall be deemed to have failed in that course.

A candidate who has secured a minimum of 50% marks in all the courses prescribed in the programme and earned a minimum of 225 credits will be considered to have passed the Masters Programme.

### Grading

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

Marks	Grade Point	Letter Grade	Class
90 +	10	S	Exemplary
85-89	9.0	D <sup>++</sup>	Distinction
80-84	8.5	D <sup>+</sup>	„
75-79	8.0	D	„
70-74	7.5	A <sup>++</sup>	First Class
65-69	7.0	A <sup>+</sup>	„
60-64	6.5	A	„
55-59	6.0	B	Second Class
50-54	5.5	C	„
49 or Less		F	Fail

Grade cards will be issued to the students, after the declaration of results. The grade card will contain the list of courses registered during the semester, the grades scored and the **Grade Point Average** for the semester.

**GPA** is the sum of the products of the number of credits of courses with the grade point scored in that programme, taken over all the courses for the semester divided by the sum of the number of credits for all courses taken in that semester. **CGPA** is similarly calculated considering the Core, Allied and Optional courses taken from first semester to tenth semester.

The results of the final semester will be withheld until the student obtains passing grade in all the courses of all earlier semesters.

### DEGREE WILL BE AWARDED AS FOLLOWS:

Those who complete successfully all the **TEN** – Semester Examinations will be issued both B.Sc., and M.Sc., degree certificates.

**(i). For UG Degree**

B.Sc., degree will be awarded after the completion of six semesters to the candidate who has passed all the Courses upto six semesters with the following Classifications based on **CGPA** after successful completion of **Ten** semesters examinations.

**For First class with Distinction** the student must earn 135 Credits, passes all the courses in the first attempt and obtain a CGPA of 8.00 or above in Part – III core and Allied courses from first to six semesters.

For the **First class** the student must earn 135 Credits, Passes all the courses and obtain a CGPA of 6.50 or above in Part – III Core and Allied courses from first to six semesters.

For the **second class** the student must earn 135 credits and pass all the courses and obtain a CGPA of 6.0 or above in part-III Core and Allied courses from first to six semesters.

**(ii) FOR PG Degree**

M.Sc., degree will be awarded after successful completion of all ten semester examinations and Earned 225 credits with the following classification based on CGPA.

**For First class with Distinction** the student must earn 225 credits Passes all the courses in the first attempt and obtain a CGPA of 8.00 or above in Part-III Core, Allied and Optional courses from first to ten Semesters.

For the **First class** the student must earn 225 credits, Pass all the courses and obtain a CGPA of 6.50 or above in Part-III Core, Allied and Optional courses from first to ten semesters.

**RANKING OF CANDIDTES**

**(i). For UG Degree**

The candidates who are Eligible to get the B.Sc degree in **first class with distinction** will be ranked on the basis of CGPA scored in Part-III Core and Allied courses of study from first semester to sixth semester.

The candidates passing with **First class** will be ranked next to those with distinction on the basis of CGPA scored in part-III core and Allied courses of study from first semester to sixth semester.

**(ii). For PG Degree**

The candidates who are Eligible to get the M.Sc degree in **first class with distinction** will be ranked on the basis of CGPA scored in Part-III Core, Allied and Optional courses of study from first semester to tenth semester.

The candidates passing with **First class** will be ranked next to those with distinction on the basis of CGPA scored in Part-III Core, Allied and Optional courses of study from first semester to tenth semester.

Candidates who obtain **First class with distinction** shall be deemed to have passed the examinations provided he / she passes all the courses prescribed for the programme at the **First Appearance**.

### **R13. TRANSITORY REGULATIONS**

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three times consecutively after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent programmes, as per the new syllabi, on the recommendations of the Head of the Department concerned.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the programmes of study and the syllabi from time to time.

**M.Sc., GEOLOGY-CBS (INTEGRATED) WITH EXIT OPTION-2014-15**

**SCHEME OF EXAMINATIONS**

**SEMESTER – I**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
ITAC 11	Language – Tamil or Hindi or French – Paper- I ITAC 11 or IHIC 11 or IFRC 11	3		3
IENC 12	Language- II English	3		3
ICEC 13	Civics, Environmental and Health Sciences	3		3
IGYT 14	Physical & Dynamic Geology	5		5
IGYA-15	Ancillary : I-Chemistry-I (Compulsory)	4		4
	<b>Total</b>	<b>18</b>		<b>18</b>

**SEMESTER – II**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
ITAC 21	Language – Tamil or Hindi or French – Paper- I ITAC 21 or IHIC 21 or IFRC 21	3		3
IENC 22	Language- II English	3		3
ICAC 23	Computer Application s-I	3		3
IGYT 24	Geomorphology	5		5
IGYA 25	Ancillary:I - Chemistry-II	4		4
IGYP 26	Ancillary: Practical-I		6	2
	<b>Total</b>	<b>18</b>	<b>6</b>	<b>20</b>

**SEMESTER – III**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
ITAC 31	Language- I Tamil / Hindi/French– Paper- I ITAC 31 or IHIC 31 or IFRC 31	3		3
IENC 32	Language- II English	3		3
IGYT 33	Crystallography	5		5
IGYT 34	Paleontology	5		5
IGYA 35	Ancillary - II -Physics-I	4		4
IGYP 36	Practical –I Crystallography & Paleontology		10	3
	<b>Total</b>	<b>20</b>	<b>10</b>	<b>23</b>

**Field visit to various Paleontological significant areas**

**SEMESTER – IV**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
ITAC 41	Language- I Tamil / Hindi	3		3
IENC 42	Language- II English	3		3
IGYT 43	Structural Geology	5		5
IGYT 44	Mineralogy	5		5
IGYA 45	Ancillary- II -Physics -II	4		4
IGYP 46	Practical - II Structural Geology & Mineralogy		6	3
IGYP 47	Ancillary Practical - II (Physics)		4	2

	<b>Total</b>	<b>20</b>	<b>10</b>	<b>25</b>
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**Field visit to various structural & Mineralogical features**

#### **SEMESTER – V**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 51	Igneous Petrology	5		5
IGYT 52	Stratigraphy & Indian Geology	5		5
IGYT 53	Basics of Remote Sensing, GIS & GPS	5		5
IGYT 54	Hydrogeology & Environmental Geology	4		4
IGYP 55	Practical – III Igneous Petrology		7	3
IGYP 56	Practical – IV - Hydrogeology & Remote Sensing		4	3
	<b>Total</b>	<b>19</b>	<b>11</b>	<b>25</b>

#### **SEMESTER – VI**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 61	Sedimentary & Metamorphic Petrology	4		4
IGYT 62	Economic Geology and Mineral Economics	4		4
IGYT 63	Geoexploration	5		5
IGYT 64	Mining Geology & Engineering Geology	5		5
IGYP 65	Practical – V Sedimentary & Metamorphic Petrology		6	3
IGYP 66	Practical – VI Economic Geology & Engineering Geology		6	3
	<b>Total</b>	<b>18</b>	<b>12</b>	<b>24</b>

**(Grand total = 135)**

#### **Semester-VII**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 71	Global Tectonics & Petrofabrics	4		4
IGYT 72	Marine Geology	4		4
IGYT 73	Coal & Petroleum Geology	4		4
	Soft Skills	4		4
IGYP 74	Practical – VII Survey		12	3
	<b>Total</b>	<b>16</b>	<b>12</b>	<b>19</b>

**Geological Mapping training - two week's duration**

#### **Semester- VIII**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 81	Advanced Crystallography, Mineralogy & Optics	4		4
IGYT 82	Ore Genesis and Industrial Minerals	4		4
IGYT 83	Mineral Beneficiation	4		4
IGYO 84	Optional – I - Field Geology	4		4
IGYP 85	Practical –VIII Mineralogy, Crystallography, Mineral Optics & Ore Petrology Geological Mapping		7	4
IGYP 86	Practical –IX. Mineral Dressing		7	3
	<b>Total</b>	<b>16</b>	<b>14</b>	<b>23</b>

**Industrial/ institutional training –Three/four week's duration.**



**Semester- IX**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 91	Advanced Igneous & Metamorphic Petrology	4		4
IGYT 92	Advanced Stratigraphy, Sedimentology and Micropaleontology	4		4
IGYT 93	Geological & Geophysical Exploration	4		4
IGYT 94	Geochemical Exploration & Isotope Geology	4		4
IGYO 95	Optional – II –Geostatistics	4		4
IGYP 96	Practical – X Geoexploration, Geochemistry & Geophysics Industrial/Institutional Training Report		6	3
IGYP 97	Practical – XI Petrology, Sedimentology & Micropaleontology		4	3
	<b>Total</b>	<b>20</b>	<b>10</b>	<b>26</b>

**Short Field visits to nearby geologically interesting places during week end & holidays**

**Semester-X**

<b>Course code</b>	<b>Theory &amp; Practical</b>	<b>L</b>	<b>P</b>	<b>C</b>
IGYT 101	Advanced Hydrogeology, Remote Sensing & GIS	4		4
IGYT 102	Medical Geology	4		4
IGYO 103	Optional – III (Internal) Atmospheric science and Meteorology	4		4
IGYO 104	Optional– IV (Internal) Geological Instrumentation & Analytical Techniques	4		4
IGYP 105	Practical – XII Hydrogeology, Remote Sensing & GIS Field Training Report		8	3
IGYP 106	Dissertations and Viva –Voce			3
	<b>Total</b>	<b>16</b>	<b>8</b>	<b>22</b>

**OVERALL TOTAL CREDIRTS = 225 (CORE 115 + 40 =155: OPTIONAL =16: SOFT SKILL= 4  
ANCILLARY =20: LANGUGE= 24: COMPUTER APPLICATION = 3: CIVICS, ENVIRONMENTAL  
AWARENESS & HEALTH =3).**

## **SEMESTER – I**

### **ICEC 13 CIVICS, ENVIRONMENTAL AWARENESS & HEALTH SCIENCES**

#### **(A) CIVICS**

##### **UNIT – I: INTRODUCTION**

Democracy – citizenship – duties of Good Citizen – Society, State and Citizen – Limits of State Activity. Indian Constitution: Preamble – Basic Features – Citizenship – Fundamental Rights – Fundamental Duties.

##### **Unit II: Political System**

Union Government: President – Prime Minister – Parliament – Supreme Court – Electoral System – State Government: Governor – Chief Minister – Center-State Relations. Local Government: Urban Administrative System – Panchayat Raj System.

##### **Books Recommended**

- B.L. Fadia, 1999, Indian Government and Politics, Agra, Sahitya Bhawan Publication.
- S.R.Maheswari, 1996, Local Government in India, Agra, Lakshmi Narain Agarwal.
- R.C. Agarwal, 2000, Indian Political System, New Delhi, S.Chand & Company.
- James H. McCrocklin, 1961, Building Citizenship, USA Allyn and Bacon, INC.,.

#### **(B) Environmental Sciences**

##### **Unit – I: Ecosystems**

Fundamental Concepts and Principles – Structure and Function – Classification – Modern concept of Ecosystem – Energy flow – Ecological Indicators.

##### **Unit – II: Environment**

Definition – Natural Resources – Classification – Conservation – Development of Public water supply – Need for protected water supply – Per capita consumption – Sanitation – Sewerage system – Disposal of sewage – kinds of pollution – Their effects of human beings.

##### **References**

- Odum, E.P, 1971, Fundamental Ecology, 3<sup>rd</sup> edition, Saunders.
- Colvinvaux. P. 1986, Ecology. John Wiley & Sons.
- Agarwal & Rana. S.V.S. Environment & Natural Resources, Society of Biosciences.
- Duggal, K.N. A 1985, Text Book on Public Health Engineering – S.Chand & Co. Ram Nagar. New Delhi.

### **(C) Health Sciences**

**UNIT – I:** Physical Health – Introduction to health – Food, meaning of balanced diet. Sources, Common nutritional deficiencies and prevention. Personal Health – Cleanliness of body. Care of Skin, Nails, Eye, Hair, Oral Health and Clothing. Body posture and good habits such as exercises – Importance of avoiding smoking, alcoholism, drugs etc.

Population explosion and family planning – Importance, Common Methods of family planning for Men & Women. Mothers and Children – Immunization of Children (importance, Schedule) care of mothers during pregnancy and after delivery.

Communicable Diseases – Symptoms and prevention.

#### **UNIT – II:**

1. Mental Health – Factors for maintenance of good mental health. (i) Adolescent problems. (ii) First Aid.
2. Environment – Ventilation, Lighting, Simple methods of Worm infestation (round worm, hook worm).

#### **Books for study and reference**

- Murray Grant, 1987, Hand Book of Community Health, Philadelphia: Lea & Febiger publications.
- Lawrence B.Chenoweth, et al., 1934, Community Hygiene New York: F.S.Croft's & Co.,
- Charles Fredric Boldman, et al., 1936, Public Health and Hygiene, Philadelphia: W.B Saunders Company.
- Harold S.Diehl, 1945, Text Book of Healthful Living, New York: Mc Graw – Hill Book Company.

### **IGYT-14 PHYSICAL & DYNAMIC GEOLOGY**

**UNIT-I:** Solar system – outer and inner planets. Earth as a member of the solar system and its relation to other planets – Size and Density of the Earth. Origin of the Earth – Nebular, Planetesimal, Tidal and Dust cloud hypotheses; their merits and demerits.

**UNIT-II:** Relief features-classification of relief feature into I, II and III orders. Mountains and mountain chains-Classification of mountains-origin of tectonic mountains; contraction theory, continental drift theory. Age of the Earth. Interior of the earth – structure and constituents.

**UNIT-III:** Continental drift – concept and evidences – Theories for the drift (Taylor & Wegner) sea floor spreading – definition and evidences. The concept of plate tectonics: a brief account on lithospheric plates, plate boundaries and mechanism of plate motion.

**UNIT-IV:** Volcanoes – types of volcanic eruption – central vent and fissure types; dormant and extinct volcanoes. Types of volcanic cones; classification of volcanoes based on the nature of volcanic activity; Products of volcanoes – distribution and causes of volcanism.

**UNIT-V:** Earthquakes–Definition– Seismic waves, definition of Focus, Epicenter and isoseismic lines. Seismograph and seismogram – Time, distance graphs – effects and causes of earth quakes – Richter’s scale of earthquake–Mercalli’s intensity scale–Distribution of earthquake.

**Books for study and reference**

- Arthur Holmes, 1992, Principles of Physical Geology, Edited by Duff.P.Mcl.D.4<sup>th</sup> Ed. Chapman and Hall, London.
- Don Leet & Sheldon Judson, 1960, Physical Geology, Prentice Hall & Co.
- Gorshkov,G & A.Yakushova,A, A, A,1967, Physical Geology, Mir publishers, Moscow
- Miller, 1949, An Introduction to Physical Geology, East West Press Ltd.
- Spencer, E.V, 1962, Basic concepts of physical Geology, Oxford & IBH,New Delhi
- Wyllie, P.J, 1971, The Dynamic Earth, John Wiley and Sons.
- Mahapatra G.B, 2002, A Text Book of Geology, CBS publishers & Distributors.
- S.M. Mathur, 2000, Elements of Geology, CBS publishers & Distributors
- P.S. Saklani, 2006, Tectonic Geology, Satish serial publishing.
- G. Singh, 2009, Earth Science Today, Discovery publishing Pvt, Ltd.

**SEMESTER – II**

**ICAC- 23 COMPUTER APPLICATIONS**

**UNIT-I: INTRODUCTION TO COMPUTERS:**

Introduction- Types of computers- Characteristics of computers - classification of digital computer systems: Introduction- Microcomputers- Minicomputers- Mainframes- Supercomputers- Network computers - anatomy of a digital computer: Functions and components of a computer- Central processing unit (CPU) – Memory - computer architecture: Introduction- The first electronic computers- The peripheral Devices- Memory

cache – Number system: Introduction- Decimal number system- Binary number system- Octal number system- ASCII code memory units: Introduction- RAM- ROM- PROM- EPROM-EEPROM- Flash memory - auxiliary storage device: Introduction- Magnetic tape- Winchester disk- Hard disk- Floppy Disk- Zip disk- Jaz disk- Super disk- Optical disk- CD-ROM- Magneto-optical (MO) drives - input devices: Keyboard- Mouse- Scanners - output devices: Introduction- Monitor- Classification of monitors-Based on color- Printer- Plotter.

## **UNIT-II: INTRODUCTION TO COMPUTER SOFTWARE:**

Introduction- Operating systems- Utilities- - Word processors- Spreadsheets- Presentation Graphics- Database management systems(DBMS)- Image processors-operating systems: Introduction- Functions of an operating system- Classification of operating systems - programming languages: Introduction- Machine languages- Assembly languages- High level languages- Types of high-level languages- Compilers and interpreters- The compilation Process-data processing: Introduction- Data versus information- File processing- Database processing-computer networks: Introduction- Overview of a network- Communication processors- Communications media- Telecommunication software- Types of networks- Network topologies- Network protocols- Network Architecture.

## **UNIT-III: MS\_WORD:**

Managing files in office- text tools- word- editing text- documenting format – styles and templates- tables and columns – mail merge, labels and envelopes Databases: Databases in access – defining and developing tables – creating queries – forms and reports – building a database application

## **UNIT-IV: SPREADSHEETS:**

Excel – Formatting worksheets and restricting data – calculating with formulae and functions – charts and pivot tables. Presentations: Power point- creating and editing slides- adding graphics, multimedia and special effects in slides. Showing the power point presentations.

## **UNIT-V: INTERNET AND WORLD WIDE WEB:**

Introduction- Internet axis- Internet basic- Internet addressing- WWW- Web browsing- Searching the web- ELECTRONIC MAIL: Introduction- Use E-mail?- E-mail-names & addresses- Mailing basics- E mail-advantages & disadvantages- Mailing lists- Newsgroups- ELECTRONIC COMMERCE: Introduction- Business-to- business E-commerce- The virtual

shop- MULTIMEDIA TOOLS: Introduction- Paint and draw applications- Graphic effects and techniques- Sound and music- Video- Multimedia authoring tools.

APPLICATIONS OF COMPUTERS in: Business and Industry, Home- Education and Training - Entertainment, Science, Medicine and Engineering

### **Books for study and reference**

- Alexis Leon and Mathews Leon, 1999, "FUNDAMENTALS OF INFORMATION TECHNOLOGY" Leon Tech World Publications..
- Kettell, Hart, Davils, Simmons, Hill "Microsoft office 2003 – The complete Reference", Tata McGraw Hill.
- Steinmetz and Nahrstedt "Multimedia: Computing, Communications & Applications", Innovative Technology series, Pearson Education, 2000.
- Margaret Levine Young, 1999, "INTERNET MILLENNIUM EDITION" Tata McGraw Hill,
- Alexis Leon & Mathews Leon, "THE INTERNET IN A NUT SHELL" Leon Press, Chennai & Vikas Publishing House, New Delhi, 2000.
- Tay Vaughan,"MULTIMEDIA MAKING IT WORKS", Osborne Tata McGraw Hill, 1996.
- Krishnan, "COMPUTER FUNDAMENTALS AND WINDOWS WITH INTERNET" technology, SCITECH PUBLICATIONS (INDIA) PVT LTD, 2000

## **IGYT-24 GEOMORPHOLOGY**

**UNIT-I:** Definition of geomorphic agent, gradation, degradation and aggradation. Weathering–definition of processes, climatic influences and products. Mass wasting - slow flowage types and rapid flowage types.

**UNIT-II:** Geological work and landforms produced by wind. Groundwater-Water table, Springs -Hot springs and Geysers. Geological work and land forms produced by groundwater in limestone terrains. Karst topography.

**UNIT-III:** Running water; Geological work and landforms produced. Base level of erosion – rapids, cascades and water falls. Drainage patterns. River capture, river meandering, stream rejuvenation, river terraces, entrenched meanders, braided streams. Lakes-origin and classification of lakes with Indian examples.

**UNIT-IV:** Definitions, origin of glacial ice-types of glaciers and their movement. Geological action and landforms produced by Glaciers. A brief outline on causes of glaciations.

**UNIT-V:** Marine erosion, deposition and resulting landforms- Sand bars, spit, berm, shingles, sea caves, sea cliff, sea arch and pillars. Shorelines – types of shorelines. Definition of submarine canyons and sea mounts. Coral reefs-types and origin.

**Books for study and reference**

- Bloom, A.L, 1999, Hand book of Geomorphology, Prentice Hall of India
- Fairbridge, R.W, 1968, Encyclopaedia of Geomorphology, Reinhold Book Corporation
- King, L.C 1967, Morphology of the Earth, 2nd Ed. Oliver & Boyd, London
- Leopold L.S. et.al., 1969, Fluvial processes in Geomorphology, Eurasia Publishing House, New Delhi
- Loback, A.K, 1974, Origin of Landforms, Oxford University Press
- Phillip G.Worchester, 1964, Geomorphology, D.Van Nostrand . Co., New York
- Sharma H.S, 1991, Indian Geomorphology, concept Publ. Co., New Delhi.
- Thornbury, W.S, 1969, Principles of Geomorphology, Wiley Eastern, New Delhi
- Thornbury.W.S, 2004, Principles of Geomorphology, CBS publishers
- Dayal. P, A, 1996, Text book of geomorphology, Shukla Book Department, Patna
- Ashutosh Gautam, 2008, Earth quake – A natural Disaster, APH Publishing Corporation

**SEMESTER – III**

**IGYT-33 CRYSTALLOGRAPHY**

**UNIT-I:** Crystal, Crystalline and amorphous forms. A brief outline of crystal structure. Morphological characters of a crystal. Crystallographic axis-Axial Ratios, Parameters-indices and symbol. Weiss and Millerian systems of crystal notation-zones-crystal forms- Holohedral, Hemihedral, Hemimorphic and Enantiomorphous forms in crystals – interfacial angles and their measurements – contact goniometers.

**UNIT-II:** Classification of crystals systems and classes- Study of the symmetry elements and forms of the Normal, Pyritohedral, Tetrahedral and Plagiohedral classes of Cubic system with special reference to well developed crystals of Galena, Spinel, Garnet, Fluorite, Diamond, Pyrite, Boracite and Cuprite.

**UNIT-III:** Study of symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal Hemimorphic, Sphenoidal and Trapezoidal classes of Tetragonal system with special reference to well developed crystals of Zircon, Rutile, Cassiterite, Vesuvianite,

Apophyllite, Scheelite, Meonite, Wulfenite and Chalcopyrite. Study of the symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal-Hemimorphic, Trapezohedral, Rhombohedral, Rhombohedral-Hemimorphic, Tri-Rhombohedral and Trapezohedral classes of Hexagonal system with special reference to well developed crystals of Beryl, Zincite, Apatite, Calcite, Corundum, Tourmaline, Phenacite and Quartz.

**UNIT-IV:** Study of Normal, Hemimorphic and Sphenoidal classes of Orthorhombic system with special reference to well developed crystals of Barite, Olivine, Topaz, Staurolite, Sulphur, Calamine, Struvite and Epsomite. Study of symmetry elements and forms of the Normal classes of Monoclinic and Triclinic systems with special reference to well developed crystals of Gypsum, Orthoclase, Augite, Axinite, Albite and Kyanite.

**UNIT-V:** Twin crystals - Definition - Evidences of Twinning - Twinning plane, twinning axis and composition plane, Laws of twinning, kinds of Twinning – Simple, Contact, Penetration and repeated twins. Polysynthetic and Cyclic twins. Secondary twins. Study of twin laws pertaining to the following crystals; Fluorite, Pyrite, Rutile, Calcite, Quartz, Aragonite, Staurolite, Gypsum, Augite and feldspars. A brief outline of imperfection and irregularities in crystals.

#### **Books for study and reference**

- M.J.Buerger, 1956, Elementary crystallography, John Wiley & Sons
- E.S.Dana, 1935 A Text Book of Mineralogy, John Wiley & Sons
- P.R.J.Naidu, 1958, Johansen's Optical mineralogy, Allied Publisher (P) Ltd
- R.C. Evans, 1966, An introduction to crystal chemistry, Cambridge University Press
- Ernest, E. Walhstrom, 1960, Optical Crystallography, John Wiley & Sons
- M.J.Buerger, 1956 Elements of Crystallography, John Wiley and sons
- S.Mitra 1994, Fundamentals of Optical, Spectroscopic and X-ray Mineralogy, available at S.R.Technico Book House, Ashok Raj Path, Patna
- S.K.Babu and D.K.Sinha, 1987, Practical Manual of Crystal Optics, CBS Publishers & Distributors
- Read, H.H, 1961, Rutley's Elements of Mineralogy, Murby and Co

### **IGYT-34 PALAEOLOGY**

**UNIT-I:** Definition of Palaeontology; General classification of Animal kingdom; Habitats and Habits of animals. Nature and mode of preservation of fossils: Unaltered hard parts, altered hard parts, petrification, permineralisation, carbonisation, recrystallisation,



silification. Geological Time Scale. Index fossil. Uses of fossils, discussion on importance of fossil in stratigraphic record.

**UNIT-II:** General morphology, classification, geological history and environmental significance of the following with examples: Phylum- Mollusca - Classes - Pelecypoda, Gastropoda and Cephalopoda; Phylum - Brachiopoda.

**UNIT-III:** General morphology, classification, geological history and environmental significance of the following with examples: Phylum- Echinodermata; Phylum-Coelenterata- Class-Anthozoa (Corals).

**UNIT-IV:** General morphology, classification, geological history and environmental significance of the following with examples: Phylum-Arthropoda- Class- Trilobita; Phylum - Hemichordata- Class- Graptoloidea.

**UNIT-V:** Classification of Plant kingdom; General morphology, classification, geological history and environmental significance of the following: Glossopteris, Gangamopteris, Ptilophyllum, Lepidodendron, Calamites, Sigillaria and Phyllothea.

#### **Books for study and reference**

- W.W. Berry, 2003, An Introduction to Paleontology, Sonali publications
- Robert R. Shrock and William H., Twenhofel, 1953, Principles of Invertebrate Paleontology Mc Graw-Hill Book Co
- H.Woods, 1961, Invertebrate Paleontology, Cambridge University press
- R.C.Moore, C.G., Lalicker and A.G. Fisher, 1952. Invertebrate Fossils, Mc Graw Hill Book Co
- Alfred S.Romer, 1963, Vertebrate Paleontology, University of Chicago press
- B.U.Haq and A.Boerma, 1978, Introduction to Marine Micropaleontology, Elsevier Publishing Company
- M.D., Brasier, 1980, Microfossils, George Allen & Unwin, London
- G.Bigot, 1985, Elements of micropaleontology, Graham & Trotman, London
- H.H.Swinerton, 1961, Outlines of Paleontology, Edward Arnold Publisher Reference Books
- Derek V.Ager, 1963, Principles of Paleoecology, Mc Graw Hill Book Co
- Benton, M.J. 1990, Vertebrate Paleontology, John Wiley
- Unwin Hyman, , 1971, Vertebrate Paleozoology, John Wiley
- J.P.Kennet and M.S.Srinivasan; 1951, Foraminifera, W.H.Freeman & Co
- Jones, 1989, Introduction to Microfossils
- P.C. Jain and M.S. Anantharaman, 1989, An introduction to paleontology, Vishal Publication, Delhi

- David.M. Raup, Steven. M. Stanley, 2004, Principles of Palaeobotany, 2<sup>nd</sup> Ed, CBS publications
- K.N. Prasad, 1999, An Introduction to palaeobotany, APH Publications Corporation

## **PRACTICAL – I**

### **IGYP 35-CRYSTALLOGRAPHY & PALAEONTOLOGY**

#### **Crystallography**

##### **Morphological study of the crystal models representing the following minerals:**

1. **Isometric system;** Normal Class: Galena, Garnet, Gold, Fluorite, Copper, Magnetite  
Pyritohedral Class: Pyrite;
2. **Tetrahedral Class:** Tetrahedrite, Sphalerite, Boracite. Plagiohedral Class: Cuprite;  
Tetragonal System: Normal Class: Zircon, Rutile, Vesuvianite, Cassiterite, Apophyllite; Tripyramidal Class: Scheelite, Scapolites; Pyramidal-Hemimorphic Class: Wulfenite; Sphenoidal Class: Chalcocopyrite ; Trapezohedral Class: Nickel Sulphate
3. **Hexagonal System:** Normal Class: Zincite; Hemimorphic Class: Zincite;  
Tripyramidal Class: Apatite: Hexagonal Trapezohedral Class: Quartz, Rhombohedral Class: Calcite, Haematite, Corundum: Rhombohedral-Hemimorphic Class: Tourmaline; Trirhomboidal Class: Dioptase, Phenacite; Trigonal Trapezohedral Class: Quartz
4. **Orthorhombic system-**Normal class: Barite, Sulphur, Olivine, Topaz, Staurolite, Hypersthene; Hemimorphic Class: Calamine, Sphenoidal Class: Epsomite
5. **Monoclinic System;** Normal Class: Gypsum, Augite, Hornblende, Epidote, Orthoclase
6. **Triclinic system;** Normal class: Axinite, Albite, Anorthite, Rhodonite.
7. **Twin Crystal** of the minerals: Spinel, Fluorite, Pyrite, Rutile, Calcite, Staurolite, Aragonite, Calamine, Gypsum, Orthoclase, Augite, Hornblende, and Albite.

#### **Paleontology**

##### **Identification and description of the following fossils:**

1. **Brachiopoda:** Lingula, Orthis, Productus, Pentamerus, Rhynoconella, Terebratula, Atrypa, Spirifer and Athyris. Ceras
2. **Mollusca:** Pelecypoda - Arca, Glycimeris (Pectenculus) Inoceramus, Ostrea, Alectryonia, Pecten, Spondylus, Trigonina, Pholadomya, Cardita, Hippurites, Cardium, Meretrix, Gryphaea, Exogyra.

3. **Gastropoda:-** Nautica, Turbo, Turritella, Hamites, Baculites
4. **Celphalopoda:** Nautilus, Goniatites, Ceratites, Ammonite, Phylloceras, Acanthoceras, Scaphites, Turritites, Belemnites
5. **Arthropoda:** Trilobites; Paradoxides, Olenus, Olenellus, Calymene, Phacops
6. **Echinodermata :** Crinoids; Encrinurus, Marsupites
7. **Blastoidea:** Pentremites
8. **Echinoidea:** Cidaris, Hemicidaris, Holaster, Hemiaster, Micraster.
9. **Hemichordate:** Graptoloidea; Tetragraptus, Didymograptus, Phyllograptus, Diplograptus, Monograptus, Rastites
10. **Plant fossils:** Calamites, Sphenophyllum, Lepidodendron, Sigillaria, Glossopteris, Gangamopteris, Ptilophyllum

## **SEMESTER – IV**

### **IGYT -43 STRUCTURAL GEOLOGY**

**UNIT-I:** Methods of representing physiographic features: topographic maps, preparation and uses of geologic maps. Attitude of planes-strike and dip of the formation -trends of outcrops and rule of 'V', Relationship between true and apparent dips-width of outcrops-true and vertical thickness and their mutual relations.

**UNIT-II:** Definition of stress and strain, compressive and tensile stress, shearing stress, couple and stages of deformation. Folds: Geometry and classification of folds-criteria for recognition of folds in field and map.

**UNIT-III:** Fault: Fault terminology-Geometrical and genetic classification of faults-Criteria for recognition of faults in field and map– Breccia and mylonite -Slicken sides and Drag Structures.

**UNIT-IV:** Joints: Joint sets and systems-joint surface-relations of joints to other structures-geometric and genetic classifications. Repetition of outcrops due to erosion, folding and faulting. Inliers and outliers-Nappe-Klippe and Fenster

**UNIT-V:** Unconformities: General Characteristics-Kinds of Unconformities-Criteria for recognition-overlap and off lap. Criteria to distinguish unconformities from faults. Brunton Compass & Clinometer-Parts and their function -their uses in field studies. Elementary knowledge about the methods of sampling and preparation of geological report.

### **Books for study and reference**

- Billings, M.P. 1974, Structural Geology, Prentice Hall of India
- F.H.Lahee, 1967, Field Geology – Mc Graw Hill Book company Inc. New York
- Ghosh, S.K. 1995, Structural Geology Fundamentals Modern Developments, Pergamon press
- Hills, E.S., 1965, Elements of Structural Geology, 2nd Ed. John Wiley, New York
- Badgley, P.C., 1965, Structure and Tectonics, Harper and Row
- Ramsay, J.G. 1967, Folding and Fracturing of Rocks, Mc Graw Hills
- Hobbs, B.E., Means, W.D. Williams, P.F. 1976. An outline of Structural geology, John Wiley
- Gokhale. N.W, 2006, A manual of problem in structural Geology, CBS publishers & Distributions
- John Suppe 1985, Principles of Structural Geology, prentice Hall publications
- Davis, G.R. 1984, Structural Geology of Rocks and Region, John Wiley
- Ramsay, J.G. and Huber, M.I., 1987, Modern structural Geology Vol, I and II Academic press
- Price N.J., and Cosgrove, J.W. 1990. Analysis of Geological structures, Cambridge Univ. Press
- Robert R. Compton, 1962, Manual of field geology, John Wiley and sons.
- H.W. Fairborn, 1949, Structural petrology of deformed rocks, John Wiley and sons

### **IGYT-44 MINERALOGY**

**UNIT-I:** Definition and scope – general characteristics of minerals – Classification of minerals- physical properties of minerals and their determination. Definition and examples of the following: Isomorphism, Dimorphism, Polymorphism, Isodimorphism, Paramorphism, Pseudomorphism-Molecular and empirical formulae of minerals.

**UNIT-II:** Introduction to general characteristics of light-polarization, plane polarized light, Brewster's law, polarization by absorption – Isotropism and Anisotropism-double refraction-Snells law. Nicol Prism-its construction and uses. Polaroids. Petrological microscope – its parts and their functions. Use of the following optical accessories-Quartz wedge, Gypsum plate and Mica Plate.

**UNIT-III:** Isotropic minerals – properties observed under parallel nicols. Uniaxial minerals: Properties under parallel and crossed nicols-dichroism -Pleochroism. Biaxial minerals properties observed under parallel and crossed nicols-optic axes, optic normal, optic axial

plane-extinction, extinction angle, interference colors. A brief outline of conoscopic characters of uniaxial and biaxial minerals.

**UNIT-IV:** Physical and optical properties, chemical composition and mode of occurrence of the minerals of the Silica group, Feldspars, Feldspathoids, Mica, Zeolite, Scapolite, Wollastonite and Rhodonite.

**UNIT-V:** Physical and optical properties, chemical composition and mode of occurrence of the following minerals-Pyroxenes, Amphiboles, Garnets, Olivine, Epidote, Beryl, Apatite, Cordierite, Staurolite, Tourmaline, Topaz, Zircon, Sphene, Chlorite, Serpentine, Andalusite, Kyanite, Sillimanite, Talc, Kaolin, Fluorite, Calcite, Dolomite, Magnesite and Rutile.

#### **Books for study and reference**

- W.A.Deer, R.A.Howie and J.Zussman, 1966, An introduction to the rock forming minerals, Longmans
- Alexander N.Winchell, 1968, Elements of Optical mineralogy, Parts I and II, Wiley Eastern (P) Ltd
- Ernest, E.Walhstrom, 1960, Optical crystallography, John Wiley & Sons
- E.S.Dana, 1935, A Text Book of, Mineralogy, John Wiley & Sons
- L.G.Berry Mason, 1961, .Mineralogy, W.H.Freeman & Co.
- Kerr, B.F., 1995, Optical Mineralogy 5th Ed. Mc Graw Hill, New York
- S.Mitra, 1994, Fundamentals of optical spectroscopic and X-ray mineralogy, available at S.R.Technico Book House, Ashok Raj Path, Patna
- Dana, E.S, 1985, A Text book of Mineralogy (Revised Edt.), Wiley Eastern Ltd.
- Read, H.H, 1962, Rutley's Elements of Mineralogy, Murby and Co.
- Smith, H.G, 1957, Minerals and microscopes, Allied publishers PVT. Ltd.
- Winchel, A.M., 1958, Optical Mineralogy, Part 1&2, John Wiley.
- Philips R.Wm and Griffen D.T, 1986, Optical mineralogy, CBS publishers.
- Donald Bloss, F, 1961, Optical crystallography- Holt Rinehart and Winston, New York.
- Berr.L.G, 2004, Mineralogy: concepts, Description & Determination, CBS publications.

**PRACTICAL –II**  
**IGYP 46- STRUCTURAL GEOLOGY & MINERALOGY**

**STRUCTURAL GEOLOGY:** Introduction to methods of representing physiographic features-contour maps-geological maps and their preparation and uses. Three point problem. Fold, fault, unconformity – Complex maps. Preparation contour maps, Geological maps and structural interpretation. Calculation of True dip and Apparent dip. Estimation of thickness, distance and depth of ore body/ width of outcrops – stereographic projection of structural features.

**Megascopic identification and description of the following minerals in hand specimen:**

**Quartz** and its macro crystalline varieties; Milky, Amethyst, Rose quartz, Smoky quartz. *Cryptocrystalline varieties:* Chalcedony, Blood stone, Agate, Flint, Chert, Jasper, Tiger eye. *Opal:* wood and milky Varieties.

**Feldspar Group:** Sanidine, Microcline, Amazon stone, Orthoclase, Moonstone, Perthite. **Plagioclase feldspars** – Albite, Oligoclase, Labradorite.

**Feldspathoid Group:** Leucite, Nepheline, Sodalite

**Pyroxene Group:** Enstatite, Bronite, Hypersthene, Diopside, Augite, Spodumene.

**Pyroxenoid Group:** Rhodonite and Wollastonite

**Amphibole group:** Anthophyllite, Tremolite, Actinolite, Hornblende, Glaucophane and Riebeckite.

**Garnet Group:** Almandine, Pyrope, Andradite

**Aluminum Silicate Group:** Andalusite, Sillimanite, Kyanite.

**Clay Mineral:** Kaolin; **Mica Group:** Biotite Muscovite

**Other minerals:** Beryl, Cordierite, Zoisite, Epidote, Olivine, Zircon, Titanite, Apophyllite, Talc, Staurolite, Topaz and Tourmaline

**Microscopic identification and description of the following minerals in thin section:**

**Quartz Varieties**

**Feldspar:** Orthoclase, Microcline, Albite, Oligoclase, Andesine, Labradorite, Bytownite, Anorthite

**Feldspathoids:** Leucite, Nepheline, Sodalite

**Pyroxene:** Enstatite, Hypersthene, Augite, Diopside, Aegirine

**Amphibole:** Hornblende, Actinolite, Tremolite, Reibeckite, Glaucothane

**Mica:** Muscovite, Biotite, Phlogopite

**Others:** Olivine, Epidote, Chlorite, Garnet, Zircon, Sphene, Tourmaline, Andalusite, Kyanite, Sillimanite, Cordierite, Staurolite, Topaz, Calcite and Apatite

## **SEMESTER -V**

### **IGYT-51 IGNEOUS PETROLOGY**

**UNIT-I:** Nature and scope of petrology – the earth shells and the chemical composition of the earth. General classification of the rocks. Composition and constitution of magma - primary magmas. Forms of igneous rocks, extrusive forms – lava flows and pyroclastic deposits, intrusive forms – concordant and discordant forms.

**UNIT-II:** Structure and texture of igneous rocks. Structures – vesicular, amygdaloidal, blocky lava, Ropy lava, pillow structure, flow structure, sheet joints, mural joints, columnar joints, rift and grain. Textures – definition, elements of texture, kinds of textures – equigranular, inequigranular, directive, intergrowth, reaction, Corona, Xenolithic and others.

**UNIT-III:** Principles and parameters in the classification of igneous rocks – Megascopic classification, Shand's saturation principles. Outlines of classification of igneous rocks - C.I.P.W, Johansson and Tyrrell classification.

**UNIT-IV:** Petrographic characteristics of Granite, Granodiorite, Syenite, Diorite, Gabbro and their hypabyssal and volcanic equivalents. Petrographic characters and origin (brief account) of Pegmatites and Aplites, Lamprophyres, Alkaline rocks, Ultrabasic rocks and Anorthosites.

**UNIT V:** Silicate systems and igneous petrogenesis. Crystallization of unicomponent magma, binary magma - Albite – Anorthite system and incongruent melting MgO – SiO<sub>2</sub> system. Bowen's reaction principle and its bearing on petrogenesis of igneous rocks. Diversity of igneous rocks in space and time – Evidences and theories of differentiation and Assimilation.

#### **Books for study and Reference**

- Barth, F.W. 1956, Theoretical Petrology, Wiley & sons.
- Bowen, N.L. 1956, The evolution of igneous rocks- Dover publications.

- Hatch F.H. Wells A.K.& Wells M.K.1949 Petrology of Igneous rocks, Thomas Murby.
- Johansson, A, 1962, Descriptive Petrology of Igneous rocks, Vol. I to IV, Allied Pacific.
- Huang W.T, 1962 – Petrography, McGraw Hill.
- Shand, S.H.J, 1990, Eruptive Rocks, John Wiley & Sons.
- Turner F.J & Verhoogen J, 1951, Ed.2. Igneous and Metamorphic Petrology, McGraw Hill.
- Tyrrell.G.W, 1970, The principles of petrology, Methuen & co.
- Williams, H.Turner F.J. & Gilbert, C.M, 1969, Petrography W.H.Freeman & Co.
- Mc Birney, 1994, Igneous Petrology, CBS publications, India.
- Paul. C. Hess, 1989, Origins of Igneous petrology, Harward University press.

## **IGYT-52 STRATIGRAPHY & INDIAN GEOLOGY**

**UNIT-I:** Introduction to stratigraphy. Principles and laws of stratigraphy. Various stratigraphic nomenclatures-Physiographic division of India- a comparative study of physiographic divisions.

**UNIT-II:** Major stratigraphic formations of India. General characteristics and descriptive study with note on the economic importance of the Dharwar rocks in south India. General characteristics and descriptive study with a note on the economic importance of the Cuddapah, Vindhyan and Aravalli systems in India.

**UNIT-III:** General characteristics and descriptive study of the following stratigraphic formations. Cambrian of salt range-Age of saline series, Permo carboniferous of Kashmir-Umaraia marine beds. Triassic of Spiti and Kashmir valley-Jurassic of Kutch, Cretaceous of Trichinopoly

**UNIT-IV:** Gondwana super group -divisions, climate and conditions of sedimentation, economic importance. Deccan trap and their age-inter trappeans and Infra trappeans. Rise of Himalayas.

**UNIT-V:** Eocene of Assam, Oligocene and Miocene of Assam, Cuddalore sandstone, Rajahmundry sandstone, Warkala beds, Quilon beds. Conditions of deposition and faunal content of Siwalik system – Karewa series.



### **Books for study and reference**

- M.S.Krishnan, 2004, The Geology of India and Burma 6<sup>th</sup> Ed., CBS Publishers and distributors, Delhi.
- D.N. Wadia, 1973, Geology of India –Tata McGraw Hill Publishing Company, New Delhi.
- Ravindra Kumar, 2008, Fundamentals of Historical geology and Stratigraphy, Wiley Eastern Limited.
- Weller, J.M. 1960, Stratigraphic principles and practice, Harper & Bros, Publishers, New York.
- Gignox, M.1955, Stratigraphic Geology, W.H.Freeman & Company
- Grabau, A.W, 1960, Principles of Stratigraphy, Dower publications.
- Read, H.H., and Watson, ., 1972, Earth's History, 1, 2, Vols, London.
- Wadia, D.Tata 1975.Geology of India, McGraw Hill Pub. Co, 4<sup>th</sup> Ed.
- King, 1967, An Introduction to oceanography, McGraw Hill Book Co., Newyork.
- Ravindra Kumar, 1985, Fundamentals of Historical Geology and Stratigraphy of India,
- Arkall, W.S, 1956, Jurassic Geology of the World, Oliver and Boyd Ltd., Edinberg. Wiley Eastern Ltd, New Delhi.
- Detrich.G, 1963, General oceanography, Interscience, London.
- Bowen, D.C. 1978, Quaternary Geology, Pergamon press.
- Shepard, F.P. 1960. Submarine Geology, John Hopkins press.
- Weller, J.M. 1960, Stratigraphic principles and practice, Harper & Bros, Publishers, New york.
- Palivaal, B.S, 1998, The Indian Precambrian, Scientific Publishers, Jodhpur.

### **IGYT- 53 BASICS OF REMOTE SENSING, GIS & GPS**

**UNIT-I:** Photogeology, definition, types of aerial photographs, scale, causes for the variation of scale, flight procedure, overlap and side-lap. Mosaics, Aerial cameras, types of films & filters, stereoscope and stereopair. Fundamentals of aerial photo interpretation – analysis based on drainage, landform and vegetation.

**UNIT-II:** Remote sensing – Definition and scope - Definition of the terms – electromagnetic spectrum –sources – Interaction of EM spectrum with earth's surface features and atmosphere, Atmospheric windows - Remote Sensing platforms , Types of Resolutions - multispectral scanning. History of space imagery – IRS series, LANDSAT series and recent satellite data.

**UNIT-III:** Image Processing System – Introduction and basic principles of image processing  
- Digital image formats - band sequential, band interleaved format – Image corrections and rectification

**UNIT IV:** Basic principles of GIS; Components of GIS- Hardware and Software module – concepts of coordinate system. Data source, spatial data, Attribute, Raster and Vector data structures – Advantages and disadvantages of raster and vector data – Digitization – Manual and Automatic.

**UNIT V:** Principles of Global Positioning System (GPS)-segments; user, ground and space segments -Differential GPS-Real Time Kinematic GPS - application of GPS in geological studies - mobile GPS.

**Book for study and reference**

- Anji Ready. M, 2000, Remote Sensing and Geographic Information systems, Book syndicate publishing company, Hyderabad.
- Drury, S.A, 1987, Image interpretation in Geology, Allen and Unwin.
- Hearn Shaw, H.M. Unwin, D.J., 1994, Visualisation in Geographical information systems, Newyork.
- Ian Heywood, Sarah corrdius and Steve Carver, 2000, An Introduction to Geographical system (GIS), Longman Ltd, Newyork.
- Kennedy, 1996, The Global positioning system and GIS: An Introduction, Ann Arboir press, Ann, Arbor, Michigan.
- Laurini,R. Thompson,D, 1992, Fundamentals of Spatial information systems, Academic press, London
- Lillesand, T.M and keifer, R.W, (1987), Remote sensing & Image interpretation, 3<sup>rd</sup> Ed., John Wiley and sons.
- Miller& Miller, 1961, Photogeology, McGraw Hill.
- Moffit, F.H. and Mikhail, E.M, 1980, Photogrammetry, Harper and Row.
- R.P.Gupta, 1991, Remote sensing Geology, Springer-Verlag, Heidelberg.
- Ray.R.G, 1969 Ariel photographs in Geological interpretation, USGS Prof. Pap. 373.
- S.N.Pandey 1987, Principles & applications of Photogeology, Wiley Eastern Ltd., New Delhi, 1987.
- Sabbins, F.F, 1985, Remote Sensing Principles and application, Freeman.
- Thomas M.Lillesand and Ralph W.Kiefer, 1994, Remote sensing and Image interpretation, John Wiley & Sons, Inc.
- Verstappan, T. H, 1977, Remotesensing in Geomorphology, Elsevier Scientific Publishing Co., Amsterdam.

## **IGYT-54 HYDROGEOLOGY & ENVIRONMENTAL GEOLOGY**

**UNIT I:** Hydrogeology: Groundwater in Hydrologic cycle – origin of ground water meteoric water, connate water and Juvenile water – vertical distribution and occurrence of ground water – zone of aeration, zone of saturation, water table and water table fluctuation. Springs – geological conditions favoring development of springs. Definition of aquifer, aquitard, aquifuge and aquiclude. Types of Aquifers-unconfined confined and perched Aquifers – Artesian wells, piezometric surface.

**UNIT II:** Rock properties affecting Groundwater, openings in rocks, types of openings-primary openings-secondary openings. Porosity, specific yield, specific retention and permeability. Groundwater movement – forces causing groundwater movement: laminar flow, turbulent flow, Darcy's law, co-efficient of permeability.

**UNIT III:** Groundwater quality – physical, Bacterial and chemical qualities – drinking water standards – major ions affecting chemical quality of groundwater. Groundwater recharge – natural and artificial recharge. Groundwater exploration – surface methods – electrical resistivity method. Groundwater status in Tamil Nadu.

**UNIT IV:** Environmental geology: Definition of ecology and environmental geology. Different ecosystems. A short account of renewable and nonrenewable resources. Environmental problems due to surface geological processes, cause, hazards and remedial measures relating to landslides, floods, and soil erosion, impact of wind on environment.

**UNIT V:** Influence of deep seated geological processes – Earthquake hazards, Earth quake prediction control and warning; Reservoir – induced seismicity – hazards of volcanism; Techniques of Volcanic prediction and human adjustments to volcanic environments. Benefits of volcanism. Environmental degradation due to mining and mineral processing Degradation of coastal environment and measures for coastal protection. Population explosion and their pressure on geological environments

### **Book for study and reference**

- A.N.Strauhler and A.N.Strauhler, 1973, Environmental Geoscience, , Wiley International Edition
- Bharat. B. Dhar, 2000, Mining & Environment, APH publishing Co.
- C.P.Tolman, C.P, 1998, Ground water, Mc Graw Hill Book Co.

- Canter RC. Knox, 1985, Ground water pollution control, Lewis Publishers.
- Davis, S.N. & Dewiest, 1966, Hydrogeology, John Wiley & Sons.
- Dr.B.D.Patak, 1988, Hydrogeology of India, Central Board Irrigation and power, Mecha Marg, Chanakayapuri, New Delhi.
- Eric F Wood, et al, 1984, Groundwater contamination from Hazardous wastes, Prentice Hall Ltd.,
- Gautam Mahajan, 1995, Groundwater surveys & Investigation, Ashish publications.
- George A James, 1999, Ethical perspectives on environmental issues in India, APH publications.
- Howman Bower, 1978, Ground water Hydrology, , Mc Graw Hill Book Co.,
- K.R.Karant, 1986, Hydrology, S.R.Technico Book house, Ashok Raj path, patna-6.
- K.R.Karant, 1998, Groundwater management, S.R.Technico Book house, Ashok Raj path, patna-6.
- Kellar, E.A. 1979, Environmental Geology, Charles. Merrill Publishing Co. Ohio.
- Lawrence Lundgren, 1986, Environmental Geology, Prentice Hall.
- M.D.Babar, 2005, Hydrogeomorphology fundamentals. Applications, Techniques, New India publications.
- M.P. Singh, 2004, Natural Resources & Renewable energy, Daya publications.
- Prithvish Nag, 1991, Essays on Environment & Resources, Deep & Deep publications
- Rangunath, H.M, 1983, Ground water, Wiley Eastern.
- Rogar, J.M.Deweist, 1965, Geohydrology John Wiley and sons,
- Todd, D.K. 1959, Groundwater Hydrology. John Wiley & Sons.
- Valdiya, K.S, 1987, Environmental Geology – Indian Context. Tata McGraw-Hill., New Delhi

### **PRACTICAL-III**

#### **IGYP 55 -IGNEOUS PETROLOGY**

##### **Megascopic identification and description of the following rocks in hand specimen:**

Mica Granite, Hornblende Granite, Pyroxene Granite, Tourmaline Granite, Schorl Rock, Graphic Granite, Pegmatite, Aplite, Mica Syenite, Hornblende Syenite, Pyroxene Syenite, Nepheline Syenite, Diorite, Gabbro, Norite, Dunite, Pyroxenite, Peridotite, Anorthosite, Dolerite, Dolerite Porphyry, Rhyolite, Trachyte, Andesite, Felsites, Basalt, Obsidian Pitchstone, Pumice, Volcanic Tuff, Volcanic breccias, Vitrophyre.

##### **Microscopic identification and description of the following rocks in thin section:**

**Acid igneous rocks:** varieties of granites and Rhyolites, Pegmatite- Aplite, and Rhyodacite, Granodiorite and Dacite.

**Intermediate Rocks:** varieties of Syenite and Trachyte, Monzonite and Trachy andesite, Diorite and Andesite, Feldspathoidal syenite and Phondite.

**Basic and ultramafic Rocks:** Varieties of Anorthosites and related rocks; Gabbro, Basalt, Norite, Pyroxenite, Dunite, Dolerites, Peridotites.

## **PRACTICAL-IV**

### **IGYP 56-HYDROGEOLOGY, REMOTE SENSING & GIS**

#### **HYDROGEOLOGY**

Delineation of hydrological boundaries. Estimation of Porosity, specific yield, specific retention and permeability. Electrical resistivity sounding for delineation of fresh and saline aquifers. Estimation of water quality and comparison with standards and suggestion for treatment to improve quality. Chemical analysis of water-Data interpretation.

#### **PHOTOGEOLOGY:**

- a. Stereo vision test and study of different types of Aerial photographs
- b. Base line information's and orientation of Aerial Photos under mirror Stereoscopes
- c. Determination of photo scale
- d. Tracing details from stereogram and stereo pairs after extracting basic interpretation
- e. Identification of landforms
- f. Preparation of land use map
- g. Identification and interpretation of drainage patterns
- h. Identification of geological, geomorphologic and structural features

#### **REMOTE SENSING:**

- A. Study of topographic maps - tracing the details obtained from topographic maps
- B. Tracing drainage basin and drainage net works from topographic maps
- C. Marginal information of Satellite images
- D. Preparation and interpretation of geomorphic landforms
- E. Preparation of Lineaments map
- F. Preparation of land use map

### **DIGITAL IMAGE PROCESSING**

- a. Starting ERDAS imagine and exploring the viewer interface
- b. Identifying image statistics, Histogram, contrast enhancement
- c. Band ratios, filters, georeferencing / rectification & subset image
- d. Principal Component Analysis
- e. View images and Map composer

### **GEOGRAPHIC INFORMATION SYSTEM**

- A. Data encoding - Scanning and conversion of images
- B. Conversion of degree minute seconds to decimal degrees
- C. Digital Map - Registration
- D. Projection and Transformation

## **SEMESTER VI**

### **IGYT-61 SEDIMENTARY AND METAMORPHIC PETROLOGY**

**UNIT I:** History of sedimentary rocks; weathering and sedimentary cycle, Nature and origin of Sedimentary rocks- composition, fabric and general classification; Textural characteristics of sedimentary rocks; Physical properties of particles - surface textures, particle shape, sphericity and roundness, particle size, crystalline textures and biogenic textures.

**UNIT II:** Internal organization and structure of sedimentary rocks-Physical Structure, Biogenic structure and Diagenetic structures, characteristics of primary structures. Classification and petrography of Clastic rocks–Rudaceous, Arenaceous and Argillaceous.

**UNIT III:** Classification and petrography of Non Clastic rocks-Dunham's and Folk' Classification of Carbonate rocks, Chert, Glauconite, Phosphorites, Carbonaceous rocks; Classification of concretions, nodules and other segregates.

**UNIT IV:** Definition, agents and kinds of metamorphism–facies, grades and zones of metamorphism – metamorphic structures and textures–Migmatites–Anatexis and Palingenesis–Cataclastic metamorphism and its significance – Thermal metamorphism – limestone.

**UNIT V:** Dynamo thermal metamorphism and its significance–plutonic metamorphism–metasomatism and metasomatic process–pneumatolytic metamorphism–Skarn rock -injection metamorphism and auto metamorphism, petrographic description of the following rock type – Quartzite, Slate, Schist, Gneiss, Marble, Hornfels and Charnockites.

**Books for study and reference**

- Friedman, G.M., Sanders, 1978, Principles of Sedimentology, E.J. John Wiley and sons, New York, Allen J.R.L., 1985., Principles of physical sedimentation, George Allen & Unwin
- Nichols, H. G. 1999, Sedimentary environments, Blackwell
- Pettijohn, F.J. Potter, P.E., and Siever, R. 1990, Sand and sandstone. Springer-Verlag
- Wilson, J.L, 1975, Carbonate facies in geological history, Springer Verlag, New York
- F.J. Pettijohn, 2004, Sedimentary rocks, Harper & Bros. 3<sup>rd</sup> Ed. CBS
- Richard C. Shelley, 1992, Applied Sedimentology, Academic press, New York
- F.H. Hatch, R.H. Rastall, 1941, Petrology of Sedimentary rocks, Thomas Murby & Co.
- Sengupta. S.M, 2007, introduction to Sedimentology, CBS publications & Distribution.
- Alex Maltman, 1994, The geological deformation of Sediments, Chapman & Hall publishers
- S.K. Tandon charu. C pant, Sm. Casshyap, 1991, Sedimentary basin of India – Tectonic context, Gyanodaya prakashan
- W.H. Twenhofel and S.A. Taylor, 1941, Methods of Study of sediments, Mc Graw Hill Book Co.
- W.C. Krumbein and L.L. Sloss, 1951, Stratigraphy and Sedimentation, W.H. Freeman and Co.
- Wilson, J.L, 1975, Carbonate facies in geological history, Springer & Verlag, New York
- H.B. Miller, 1962, Sedimentary petrography, Vols, I and II, George Allen and Unwin Ltd.
- M.E. Tucker, & V.P. Wright, 1990, Carbonate Sedimentology, Maxwell Scientific Publication, London
- F.J. Turner & J. Verhoogen, 1960, Igneous and Metamorphic petrology, Mc Graw Hill Book Co.
- Yardley, B.N.W, 1989, An introduction to Metamorphic petrology. Longman, New York
- Butcher and Frey, 1994, Petrogenesis of metamorphic rocks, Springer Verlag
- Kretz, R, 1994, Metamorphic crystallization, John Wiley.
- G.W. Tyrrell, 1989, Principles of petrology, Methuren and Co., (Students Ed.)
- H. Williams, F.J. Turner and C.M. Ghilbert, 1954, Petrography, W.H. Freeman and Co.
- H.G.S. Winkler, 1979, Petrogenesis of Metamorphic rocks, Springer Verlag Vth Ed.

- Bhaskar Rao, 1986, Metamorphic petrology, International Book House, Second Ed. 12, U.B. Bungalow Road, Delhi.
- R.H.Vernon, 1976, Metamorphic process, George Allen and Unwin Ltd.
- Roger Mason, 1984, Petrology of the Metamorphic rocks, CBS Pub. & Distributors.
- W.W. Moorhouse, 1969, The study of rocks in thin sections, Harper and sons.

## **IGYT-62 ECONOMIC GEOLOGY AND MINERAL ECONOMICS**

**UNIT I:** An outline of the processes of formation of mineral deposits. Magmatic, Sublimation, Contact metasomatic, Hydrothermal, Residual, Placer, Oxidation and Supergene enrichment, evaporation. Classification of ore deposits–Lindgren’s and Bateman’s classification.

**UNIT II:** Important ores, their composition, mode of occurrence, uses and distribution in India with reference to the following metals; Aluminum, Gold, Copper, Lead, Zinc, Iron, Manganese, Chromium, Uranium and Thorium.

**UNIT III:** Raw material required for the following industries and their qualities, mode of occurrence and distribution in India; Refractory, Abrasive, Ceramic, Glass, Cement, Paint and Pigment, Fertilizer, Building stones and gemstones – their mode of occurrence and distribution in India.

**UNIT IV:** Mode of occurrence, origin, use and distribution in Tamil Nadu of the following mineral deposits: Iron ores of Kanjamalai, Gauthimalai, Magnesite and Bauxite deposits of Shevaroy hill, Gypsum beds of Chaitali, Graphite beds of Sivaganga, Quartz deposits of Karur region, Clay beds of Cuddalore and Trichinopoly. Lignite beds of Neyveli.

**UNIT V:** Classification of mineral resources. Mineral economics and its concept. Strategic, critical and essential minerals. Tenor, grade and specification of important minerals with relevant domestic examples. Mineral taxation. Introduction to Indian Mining laws. Significance of minerals in national economy. National Mineral policy 2008. National mineral production, export and import and price of major minerals in India.



### **Books for study and references**

- Alan M. Bateman, 1961, Economic mineral deposits, Asia Publishing House, Mining Geology
- Evans, A.M., 1993, Ore Geology and industrial minerals, Blackwell
- R.K. Sinha and B.N.L. Sharma, 1973, Mineral Economics, Oxford and IBH Publishing Co.
- S. Deb, 1980, Industrial minerals and Rocks of India, Allied Publishers Pvt. Ltd.
- K.V.G.K. Gkhale and T.G. Rao, 1972, Ore deposits of India, Thompson press Ltd., Delhi
- S. Krishnaswamy, 1972, India's Mineral Resources, , Oxford and IBH Publishing Co.
- J. Coggin Brown & A.K. Dey, 1955, India's Mineral Wealth, Oxford University Press
- N.K.N. Aiyengar, 1964, Minerals of Madras, Dept. of Industries and Commerce, Madras
- Robert, D. Nininger, D. Van, 1955, Minerals for Atomic Energy, Nostrand Co.
- R.B. Sing, 2007, Principles & practices of Modern coal mining, New Age International Pvt.
- Ralph, B. Grim, 1953, Clay Mineralogy, Mc Graw Hill Book, Co.
- Lindgren, 1953, Mineral deposits, McGraw Hill
- P.K. Banerjee, S. Ghosh, 1997, Elements of prospecting for non fuel minerals deposits, Allied publishers
- A. Levorsen, 2004, Geology of petroleum 2<sup>nd</sup> Ed, CBS publication
- A.K. Srivastava, 1998, Coal mining industry in India, Deep & Deep publications
- Chatterjee. K.K., 2006, Uses of Energy minerals & changing Techniques, New Age Publications
- Stephan E. Kesler, 1904, Mineral Resources, Economics and the environment, Macmillan publications
- Asok Mookherjee, 1999, Ore genesis A Holistic Approach, Allied publishers

## **IGYT-63 GEOEXPLORATION**

**UNIT I:** Geological exploration: marginal information of toposheets and study of field equipment. Pitting and trenching the ore bodies. An introduction to drilling—types and uses, sampling.

**UNIT II:** Geophysical Exploration: a concise account of limitations and applications of various geophysical exploration methods; principles, instruments, field procedures and interpretations of electrical methods with particular reference to resistivity—Self potential methods.

**UNIT III:** Geodesy of the earth. Newton's law and its application. The earth's gravitational field-gravity measuring instruments - Corrections & anomalies. Elastic properties of rocks. Seismic waves: Types of seismic waves - their propagation and characteristics, geophones, principle of refraction.

**UNIT IV:** Basic concepts and principles of magnetic prospecting. Magnetism of the earth and palaeomagnetism - Magnetic Susceptibility of rocks. Instruments employed in magnetic prospecting, Principles of radioactive prospecting. Radioactive decay, radioactivity of rocks and minerals - instruments, field procedure and interpretation employed in radioactive survey.

**UNIT V:** Geochemical exploration: Origin and abundance of geochemical elements in the earth's crust. Geochemical classification of elements. Geochemical exploration for gold and copper. Application of geochemistry in mineral exploration studies.

**Book for study and references**

- McKinstry H.E, 1960, Mining Geology; Asia Publishing House
- Mathur S.M, 2001, Guide to Field Geology; Prentice Hall of India
- Ramachandra Rao M.B, 1975, Outlines of Geophysical Prospecting – A manual for Geologist, University of Mysore
- Dobrin. M.B, 1981 – introduction to Geophysical prospecting. McGraw – Hill
- Mason. B, 1966, Principles of geochemistry – Willey Toppan.
- H.E. Hawkes and Webb, 1965, Geochemistry in Mineral Exploration, Harper and Row Publishers.
- D.A. Cox, 1995, The elements of Earth, Oxford University Press, Newyork
- Sharma, P.V, 1986, Geophysical methods in Geology, Elsevier.
- Govett, G.J.S. (Ed) , 1983, Handbook of Exploration Geochemistry, Elsevier,
- Stanislane, M, 1984, Introduction to Applied Geophysics, Reidel Publishers.
- Parasnis, D.S, 1975, Principles of Applied Geophysics, Chapman and Hall
- Pascal, 2<sup>nd</sup> Ed., 1977, Geochemical prospecting methods, Ustrendi.
- Brooks, A.R., 1972, Geobotany and Biogeochemistry in mineral exploration, Harper and Row.
- Rose, A.W.Hawks, H.E. and Webb, J.A, 1979, Geochemistry in Mineral Exploration, Academic press.
- J.G. DE Geoffroy, T.K. Wignall, 1985, Designing optimal strategies for mineral Exploration, Plenum press.

## **IGYT-64 MINING GEOLOGY & ENGINEERING GEOLGY**

**UNIT-I:** Role of geology in mining industries. Introduction to ore body investigation methods. Lithological association of ore minerals. Rock sampling techniques. Ore reserve estimation techniques. Definitions of mining terms: hanging wall, foot wall, shaft, adit, roof, drive, cross cut, tunnel, raise, winze, stope, assay value, cut off grade and run off mine.

**UNIT-II:** Introduction to surface mining. Surface mining methods. Drilling methods and types of drills. Mine explosives and magazines. Bench parameters. Haulage layouts. Granite mining. Alluvial mining. Introduction to underground mining methods. Underground mine layouts. Classification of mining methods.

**UNIT-III:** Outline of underground metallic mining methods. Outline of underground coal mining methods. Detailed study of ventilation and illumination. Designing of transport layout. Rail free transport systems & rail transport. Excavators – shovel dragline, front end loaders, bucket wheel excavators, back hoe, surface miner, rock breaker and belt conveyor system. Sub-surface mining methods. Mine safety and safety regulations. Safety devices and safety inspection. Guide lines for Preparation of mine plan. Environmental Impact Assessment and Management plan for different mine projects. Mine fire – causes, effects and prevention.

**UNIT-IV:** Engineering Geology: The role of Geology in Civil Engineering. Engineering properties of rocks. Properties of building stones. Types of earth movements–Landslides, their causes, classification and preventive measures. Geological investigations pertaining to the foundation of bridges, buildings and roads.

**UNIT-V:** Types of Dams – Geological Investigations of Dam sites. Failure of dam and case histories. Geological investigations proceeding tunneling. Problems relating to tunneling in hard and soft grounds.

### **Books for study and reference**

- Ajoy K Ghose, 1997, Small / Medium scale mining-A global prospective, National Institute of small mines.
- B.Boky, 1967, Mining, Mir publishers, Moscow.
- C.J.Young, 1940. Elements of Mining , Mc Graw Hill Book co.,
- Cedric E.Gregory, 1955, Rudiments of Mining Practice, Trans Tech. Pub.

- D.P.Krynine and W.R.Judd, 1998, Principles of Engineering and Geotechniques, Mc Graw Hill Book co.
- H.E. Mc Kinstry, 1960. Mining Geology, Asia publishing house
- H.F.Legget, 1962, Geology and Engineering, , Mc Graw Hill Book co.
- K.K. Chatterjee, 1993, An introduction to Mineral economics, Wiley Eastern Limited.
- K.Subramanya, 1994, Engineering Hydrology, Tata Mc Graw Hill
- MT. Maruthesha Reddy, 2008, Applied Engineering geology Practicals 2<sup>nd</sup> Ed, New Age Publications.
- Prof A.K. Ghose & Prof B.B. Dhar, 2000, mining challenges of the 21<sup>st</sup> century, APH Publications.
- Q.Zaruba and V.Menci, .1976, Engineering Geology, Elsevier Scientific Publishing Co.
- R.K Sinha and B.N.L Sharma, 1973, Mineral Economics, Oxford and IBH Publishing Co.
- R.N.P.Arogyaswami, 1970. Course in Mining Geology, Oxford and IBH Publishing house,
- Rudiments of Mining Practice, E.Gregory (1983)Trans Tech. Pub.
- US. Department Interior Bureau of Reclamation, 1989, Engineering geology field manual, Scientific publications.
- William, C.Peters, 1982, Exploration and Mining Geology, John Wiley and sons, Second Ed.

## **PRACTICAL-V**

### **IGYP 65-SEDIMENTARY AND METAMORPHIC PETROLOGY**

#### **Megascopic identification and description of the following rocks in hand specimen:**

##### **Sedimentary:**

Conglomerate, Breccia, Sandstone, Arkose, Grit, Flagstone shale, Laterite, Limestone, Clay, Chalk, Flint, Chert, Phosphatic Nodule, Peat, Lignite, Bituminous Coal, Anthracite`

##### **Metamorphic:**

Mica gneiss, Hornblende schist, Chlorite Schist, Chlorite mica schist, Chlorite garnet schist, Mica garnet schist, Mica Staurolite schist, Talc schist, Graphite Schist, Phyllite, Grayscale, Red slate, Quartzite, Marble, Dolomite, Ophicalcite, Quartz magnetite rock, Amphibolite, Eclogite, Khondalite, Gondite, Charnockite, Calcgranulite

**Microscopic identification and description of the following rocks in thin section:  
Sedimentary:**

Conglomerate, Breccia, Sandstone, Arkose, Grit, Shale, Laterite, Limestone, Oolitic limestone, Shell limestone, Clay, Chalk, Flint, Chert, Coal.

**Metamorphic:**

Mica schist, Chlorite schist, Hornblende schist, Staurolite schist, Actinolite Schist, Tremolite schist, Garnetiferous mica schist, Slate, Mica gneiss, Pyroxene gneiss, Charnockite, Marble, Eclogite, Amphibolites, Khondalite, Cordierite sillimanite gneiss.

**PRACTICAL -VI**

**IGYP 66 ECONOMIC GEOLOGY & ENGINEERING GEOLGY**

**ECONOMIC GEOLOGY**

**Identification and description of the following economic minerals:**

Haematite, Magnetite, Limonite, Pyrolusite, Psilomelane, Chromite, Ilmenite, Rutile, Wulframite, Bauxite, Cuprite, Pyrite, Pyrrhotite, Marcasite, Chalcopyrite, Chalcocite, Galena, Reaglar, Orpiment, Stibnite, Molybdenite, Cinnabar, Sphalerite, Monazite, Pitchblende, Barite, Celestite, Gypsum, Anhydrite, Rhodochrosite, Magnesite, Calcite, Dolomite, Malachite, Azurite, Cerrusite, Siderite, Smithsonite, Strontianite, Witherite, Phosphatic Nodule, Apatite, Asbestos, Graphite, Sillimanite, Kyanite, Corundum, Yellow ochre & Red ochre.

**Reserve Estimation Methods:**

- i) Section – Preparation of isochore and isopach maps.
- ii) Estimation of ore reserves by distance of influence methods: included and extended area, triangular and polygonal methods.
- iii) Reserve calculation for hydrocarbons, coal seams and placer deposits from maps

**ENGINEERING GEOLGY**

Engineering applications of Geology in the planning and construction of dams and reservoirs. Study of maps and models of important engineering structures as dam sites and tunnels. Study of properties of common rocks with reference to their utility in engineering projects. Important case studies of Dams. Prevention of leakage reservoirs and silting of reservoirs. Tunnels, engineering properties of rocks. Flood control - Soil conservation.

## **SEMESTER VII**

### **IGYT-71 GLOBAL TECTONICS & PETROFABRICS**

**UNIT–I:** Isostasy concepts: Airy's and Pratt's theories. Continents – Evolution of continents and ocean basins and their permanence. Continental drift- Theories of continental drift. Rift valleys and their characteristics and origin. Theories of palaeomagnetism – Polar wandering. Ice ages and their periodicity.

**UNIT–II:** Plate tectonics – types of plate boundaries – characteristic features of accretionary, conservative and destructive boundaries – Global tectonics and mountain building – Indian plate tectonics – configuration of Indian plate – mobile belts in peninsular India – Evolution of Himalaya and Himalayan tectonics.

**UNIT–III:** Concepts of Geomorphology, Geomorphic classification of landforms: Global evolution of denudational-tectonic- fluvial-coastal-aeolian-glacial-anthropogenic landforms. Drainage pattern. Geomorphic cycle and their interpretation. Evolution of typical geomorphic features of India. Cretaceous –Tertiary boundary with reference to India. Application of geomorphic features in relation to structure and lithology.

**UNIT–IV:** Mechanical properties of rocks-deformation – stages – stress, strain ellipsoids - Folds: Geometry, mechanics and causes. Evidences of buckling superposed folding and interference pattern. Faults and Shear zone: Causes and dynamics of faults and shear zones. Joints and Veins: Analysis of joints and their tectonic significance. Minor structures – Foliation and lineation and their relation to major structures. Unconformity - recognition of top and bottom of deformed strata.

**UNIT–V:** Structural analysis: Principles and elements of structural analysis of simple and complex structures – Macroscopic to microscopic scale. Petrofabric analysis: Field technique-laboratory technique and interpretation. Stereographic projection – equal area projection and structural analysis – folding & fabrics. Tectonites – classification and geological significance. Stress-Strain analysis and small-scale structures and their relation to major structures.

### **Books for study and reference**

- Davies, F, 1999, Dynamic Earth, Cambridge University Press
- Billings, M.P, 1974, Structural Geology, Prentice Hall of India
- Hobbs, Means and William, (1976), An outline of Structural Geology, Wiley International Edition
- Robert R. Compton, 1962, John Wiley & Sons, Manual of field geology, INC, Newyork, London
- Windley. B.F., John Wiley & sons, 1978, The Evolving continents, Allen Cox, 1973. Edit Plate Tectonics, Freeman and company
- Park, R.C. Blackies, 1988, Geological Structures and moving plates, Chapman and Hall, New York
- Thornbury, W.S. 1969, Principles of Geomorphology, Wiley Eastern, New Delhi
- Leopold, L.S. et.al., 1964, Fluvial processes in Geomorphology, Eurasia Publishing House, New Delhi
- Fairbridge, R.W. 1968, Encyclopedia of Geomorphology, Reinhold Book Corporation
- King, L.C. 1967, Morphology of the Earth, 2<sup>nd</sup> Ed. Oliver & Boyd, London
- Dayal, P. 1990. A Text Book of Geomorphology, Shukla Book Depot, Patna
- Ravindra kumar 2008 Fundamentals of Historical geology and stratigraphy of India, New Age International (P) Limited Publishers
- Phillips Edward, F.C. 1994 The use of Stereographic projection in Structural Geology, Arnold Publishers
- Jean Goguel, 1962, Tectonites, W.H. Freeman & Co.
- Ramsay, J.G., Huber, M.I., 1987, Vol.2, The Techniques of modern Structural Geology, Folds and Fractures
- Allen Cox, 1973, Plate Tectonics, Freeman & company
- Moores. E and Twiss R.J, 1995, Tectonics, Freeman & company
- Keary. P, and Vine. F.J, 1990, Global Tectonics, Blackwell
- Valdiya. K.S, 1998, Dyanamic Himalaya, University press, Hyderabad
- L.Rama Rao , 1964, The problem of the Cretaceous – Tertiary Boundary with special Reference to India and adjacent countries , GSI Memoir No:2
- B.P. Radhakrishnan Etd., 1968, Cretaceous – Tertiary formations of south India, Geological society of India, GSI Seminar Volume

## **IGYT 72 MARINE GEOLOGY**

**UNIT-I :** Oceanography- definition, historical development of marine geology, division of oceanography. Origin of seawater, origin of life. World's oceans & seas. Physical and chemical properties of seawater. Classification of coasts by Johnson, Shepard and Cotton.

**UNIT-II:** Ocean morphology: Continental margin, Shelf, Slope, Rise, Submarine canyons, Oceanic ridges, Abyssal hills, Seamounts and Guyots and Trenches. Plate tectonics and origin of ocean basins: Ocean circulation causes and character, surface currents, deep water circulation.

**UNIT-III:** Ocean waves and tides: Wave parameter, mechanism of wave formation, Wave refraction, types of seawaters, tides. Shore line processes and sediments: Shore and shorelines, Processes, features, marine sediments and their distribution, rates of sedimentation, deep sea sediment classification.

**UNIT-IV:** Life in the ocean: Major environmental domain, modes of marine life, ocean life, marine plants and animals. Calcareous and siliceous microfossils. Physical factors affecting marine life. Physical resources: Heavy minerals, Petroleum, Manganese nodules, Phosphorites, Sulphur, Dissolved salts. Wave, Tidal, Thermal energy from ocean.

**UNIT-V:** Sea level processes and effects. Ocean management and conservation. Law of the sea. Environmental oceanography: Oil pollution, Radioactivity, Chlorinated hydrocarbon, metallic and non metallic pollution.

### **Books for study and reference**

- JJ. Bhatt, 1980, Oceanography- Exploring the Planet Ocean, D.Van Nosrand Company, USA
- Kuenen, Ph.H. 1950, Marine Geology, John Wiley & Sons
- D.S. Cronon, 1996, Under water minerals, Kluwa publications
- A.K.Ghosh, 1987, Marine mineral resources, Oxford and IBH
- Seibold, E.E.Berger, W.H. 1982, The ocean floor and sediments, Springer-Verlag
- Detrich, G.1963, General Oceanography, Interscience, London.
- J.P.Kennet, 1982 Marine Geology, Prentice Hall, Inc. New Jersey
- K.Seibold and W.H.Berger, 1976, The sea floor, Springer-Verlag, Newyork
- Kingh, 1974, Oceanography, CBS
- H.W. Menard, 1977, Ocean Science, W.H. Freeman & company
- E. Ahmed, 1982, Coastal geomorphology of India ,CBS
- PC. Sinha, 1994, Sea level rise, CBS
- Sverdrup et al., 1982, The oceans, Prentice Hall. inc.



- F.P.Shepard, 1960, Submarine Geology- John Hopkins press.
- PA Pirazzide, 1998, Sea level change, New Age publications
- Tom Garrison,1995, Essential of Oceanography, Wadsworth Publishing Company
- Eric Bird,2007., Coastal Geomorphology – An introduction (second edition)., John Wiley & Sons, Ltd

## **IGYT-73 COAL & PETROLEUM GEOLOGY**

**UNIT–I:** Geological basis of coal formation. Classification and ranks of coal. Development of coal facies, types of deposition and diagenesis of coal. Coalification & Bituminization. Physical and chemical properties of coal. Sampling of coal, application of coal petrography.

**UNIT–II:** Prospecting and valuation of coal lands. Lignite deposits in Neyveli. Carbonization and gasification of coal - Production of coal- export and import- conservation of coals. Preparation of coal for industrial purposes. Coal production in India and uses of Coal. Distribution of Gondwana and Tertiary coal fields in India.

**UNIT–III:** Physical and Chemical properties of Petroleum. Origin and composition of petroleum and natural gas, source rocks, reservoir rocks and traps. Migration and accumulation of oil and gas. Porosity and permeability of Reservoir rocks. Types of petroliferous basins, relations between basin types and hydrocarbon richness. Classification of petroliferous basins in India. Detailed study of stratigraphy, structure and petroleum geology of Assam shelf, Cambay, Bombay, Krishna-Godavari and Cauvery Basin.

**UNIT–IV:** Introduction to drilling methods, types of drilling operations, designing an oil well and down hole equipment. The drilling rig - its components and functions. Drilling fluids, Wellheads, Casing and cementing operations. Principles of kick control, fishing jobs. Drilling methods and equipment for directional, horizontal and multilateral wells. Types of offshore drilling rigs.

**UNIT–V:** Duties of a well-site geologist. Geotechnical order. Mud logging. Fundamentals of Petrophysics. Archie's Formula- Porosity, Permeability and Well logging. Borehole environment and Invasion profiles. Principles, Methods and application of logging tools - Gamma ray , SP, Resistivity, Sonic, Density, Neutron, Caliper, Dip meter, Preparation of composite logs. Principles of formation testing. Well completion and Enhanced Oil Recovery.

### **Books for study and reference**

- A.L.Levorson, , 1972, Geology of Petroleum, Vakils, Peter and Simon Limited, Bombay,
- E.S. Moore, 1980, Coal, John Wiley & Sons
- Asquith, G. and Gibson, C 1982, Basic Well Log, Analysis for Geologists, Academic Press, London
- Baker, R. A, 2001, Primer of Oil well Drilling: A Basic Text of Oil and Gas Drilling, Petroleum Extension Service, University of Texas at Austin
- Biswas, S.K., Dave, A., Garg, P., Pandey, J., Maithani, A. and Thomas, N.J. (Eds.1993 Proceedings of 2nd Seminar on Petroliferous Basins of India, Dehradun, Dec.18-20, 1991, Vol. 1, 2 & 3 Indian Petroleum Publishers, Dehradun
- Chilinger, G.V. and Vorabutr, P. 1981, Drilling and Drilling Fluids. Elsevier Science, Amsterdam
- Darling, T. 2005, Well Logging and Formation Evaluation, Elsevier Science, Amsterdam.
- Gupta, P.K. and Nandi, P.K. 1995, Wellsite Geological Techniques and Formation Evaluation: A User's Manual, Vol. I, Oil and Natural Gas Corporation, Dehradun
- Hyne, N.J. 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, 2nd edition, Pennwell Corporation, Tulsa, Oklahoma
- North, F.K. 1985, Petroleum Geology, Allen & Unwin, London
- Selley, R.C. 1970, Elements of Petroleum Geology, 2nd Edition, Academic Press, London
- Serra, O. 1984, Fundamentals of Well Log Interpretation, Vol.1 and 2. Elsevier, Amsterdam
- Singh, L. 2000, Oil and Gas Field of India, Indian Petroleum Publishers, Dehra Dun
- Tiab, D. and Donaldson, E.C. 1991, Petrophysics: Theory and Practice of Measuring Reservoir Rock and Whittaker, A. Mud Logging Handbook, Prentice-Hall, Englewood Cliffs
- P.N.Ganju, 1955, Memoirs of the GSI Petrology of Indian coals, Vol.83.
- N.L.Sharma & K.S.Ram, 1983. Introduction to Geology of coal and Indian coal fields, Dhanbad Publishers
- Bjorkee, K.O., 1989 Sedimentology and Petroleum Geology, Springer Books, India.
- Ross C.A, 1984, Geology of Coal, Narosa book distributors

### **IGYP-74 PRACTICAL-VII SURVEY**

- Chain, Plane table and principles of Levelling by dumpy level-principles of theodolite and microptic alidade-preparation of base maps by radial contouring and block contouring methods and marking of geological formation in them. Study of GPS.

## **SEMESTER VIII**

### **IGYT-81 ADVANCED CRYSTALLOGRAPHY, MINERALOGY & OPTICS**

**UNIT-I:** Crystalline and amorphous states of matter, symmetry elements, translation, rotation, reflection, inversion, screw and glide-point groups and crystal classes-Derivation of 32 crystal classes based on Schoenflies notation-Hermann Mauguin system. Correspondence between Schoenflies and international notation-Bravies lattices and their derivation-An outline of space groups.

**UNIT-II:** X-ray diffraction method-basic principles. Powder methods - Bragg's law and its application-Calculation of cell dimensions-Identification of minerals from X-ray diffractogram. Crystal Projections-Spherical, Stereographic and Gnomonic-Zones, Zone symbols and Weiss Zone law equation-Law of an harmonic ratio - Napier's rule - Equations to Normal - Calculation of interfacial angles, axial ratios, Miller indices.

**UNIT-III:** Optical classification of minerals: Optical properties under Polarizer and analyzer- Optic sign, Uniaxial and biaxial interference figures. Primary and secondary optic axes - Optic axial angle measurements - Optic orientation-Dispersion in Crystals-Optical anomalies. Atomic structure-Chemical bonds. Structural classification of silicate minerals. Isomorphism - Solid solution - Atomic substitution-Exsolution – order - disorder relations – Polymorphism and Pseudomorphism - Fluorescence in minerals, Metamict state - staining techniques and micro - chemical tests.

**UNIT-IV:** Description of chemical, optical and physical properties, distinguishing features, paragenesis of the following important minerals: Quartz group, Feldspar group, Feldspathoid group, Zeolite group and Scapolite group. Chain silicates: Pyroxene group, Amphibole group & Wollastonite. Sheet silicates: Mica group, Chlorite group and Clay minerals.

**UNIT-V:** Description of chemical, optical and physical properties, distinguishing features, paragenesis of the following important minerals: Ortho and ring silicates: Olivine group, Garnet group; Alumino silicates, Epidote group, Zircon, Staurolite, Beryl, Cordierite and Tourmaline. Non-silicate- Spinel group, Carbonates and Phosphates. Properties of precious and semi-precious minerals.

### **Books for study and reference**

- W.A.Deer, R.A.Howie and J.Zussman, Longmans, 1966, An Introduction to Rock Forming minerals
- Ernest, E.Walstrom, 1960, Optical Crystallography, John Wiley & Sons
- E.S.Dana, 1935, A Text Book of Mineralogy, John Wiley & Sons
- L.G.Berry Mason, 1961, Mineralogy, John Wiley & Sons
- Kerr, B.F, 1959, Optical Mineralogy, 5<sup>th</sup> Ed. Mc Graw Hill, New York, Evans, 1966. An introduction to Crystal chemistry, R.C., Cambridge University Press,
- Deer, W.A., Howie, R.A., Zussman, J., 1962, Longmans,. Rock forming minerals (Vols1-5).
- W.H .Berger, 1956. Elements of Crystallography, John Wiley and sons
- S. Mitra, 1986 Fundamentals of Optical, Spectroscopic and X-ray Mineralogy, S.R.Technico Book House, Ashok Raj Path, Patna
- Ralph B.Grim, 1953, Clay mineralogy, Mc Graw Hill Book Co.
- S.K.Babu and D.K.Sinha, 1987, Practical Manual of Crystal Optics, CBS Publishers & Distributors
- Read.H.H, 1982, Rutley's Elements of Mineralogy, CBS, publishers
- A.E.H. Tutton, 1922, Tabular methods in crystallography, Thomas Murby and Co., Fleet Lane, London
- L.V.Azaroff & W.H.Berger, 1959, The powder method, Mc Graw Hill Book Co.
- F.W. Heinrich, 1965, Microscopic identification of Minerals, McGraw hill Book Co.
- American mineralogist special volumes on Mineralogy

## **IGYT-82 ORE GENESIS AND INDUSTRIAL MINERALS**

**UNIT-I:** Processes of the mineral formation: Magmatic concentration, sedimentation, metamorphism, metasomatism, hydrothermal process, residual and the mechanical concentration. Evaporites, oxidation and supergene enrichment, stratiform and strata bound deposits. Classification of mineral deposits. Controls & Localizations -structural, stratigraphic, lithological and zonal distribution. Metallogenic epochs and the provinces. Geological thermometry and modern concept of ore genesis.

**UNIT-II:** Detailed study of precious and ferrous metals with regard to their mode of occurrence, distribution in India, origin and uses: Gold, Silver, Iron, Chromium, Manganese and Molybdenum.

**UNIT-III:** Study of non-ferrous metals with regard to their mode of occurrence, distribution in India, origin and uses: Copper, Lead & Zinc, Tin, Aluminum, Radioactive metals and rare metals.

**UNIT-IV:** Study of non-metallic minerals with regard to their mode of occurrence, distribution in India, origin and uses: Abrasive minerals, Building materials, Dimensional & Polished stones, Refractory minerals, Ceramic minerals, Fertilizer minerals and Gem stones. Granite industries in Tamil Nadu.

**UNIT-V:** Ore microscope: Principles of ore microscopy-description of ore microscope. Polishing and Mounting of ores. Physical and Optical properties of ore minerals. Ore textures and paragenesis. Microchemical techniques. Application of ore microscopy.

**Books for study and reference:**

- Alan M. Bateman, 1961, Economic mineral deposits, Asia Publishing House.
- S. Deb, 1980, Industrial minerals and Rocks of India, Allied Publishers Pvt. Ltd.
- K.V.G. K.Gokhale & T.G. Rao, 1972, Ore deposits of India, Thompson press Ltd. Delhi, India.
- W. Lindgren, 1933, Mineral deposits, Mc Graw Hill Book Co.
- N.K.N. Aiyengar, 1964, Minerals of Madras, Dept. of Industries and Commerce, Madras.
- S. Krishnaswamy, 1972. India's mineral Resources, Oxford & IBH Publishing Co.
- E.S. Bastin 1957 Interpretation of ore textures. Geol.Soc. Amer., Memoir no: 4.
- C.Schouten, 1962, Determinative tables for Ore Microscopy, Elsevier Publishing Company
- W.Uvtenbogaardt & E.A. Burke, 1971. Tables of Microscopic identification of Ore Minerals, Elsevier Publishing Company
- J.Coggin Brown & A.K.Dey, 1955, India's Mineral Wealth, Oxford University Press,
- Robert, D.Nininger , 1955, Minerals for Atomic Energy, ,D.van Nostrand Co.,
- Guilbert, J.M. and Park, Jr.C.F. 1956, Geology of ore deposits, John Wiley.
- Eugene N.Camerron , 1961, Ore microscopy, John & Wiley & Sons,
- James R. Craig and David. J. Vaughan, Ore microscopy and Ore petrography, John & wiley and Sons.
- R.L. Stanton, 1972, Ore petrology, , Mc Graw Hill Book Co.
- P.R.Ingerson, 1989, Introduction to practical ore microscopy, Logman Scientific and Technical, Publishers
- Sawkins, F.J. 1984, Metal deposits in relation to Plate tectonics, Springer Verlag.
- Barnes, H.L. 1979, Geochemistry of Hydrothermal ore deposits, John Wiley
- Klemm, D.D. and Schneider, H.J. 1977, Time and Strata sound ore deposits, Springer Verlag

## **IGYT-83 MINERAL BENEFICIATION**

### **(Department of Chemical Engineering)**

**UNIT-I:** General principles-Ores, ore types and properties-Scope of ore dressing. A description study of the following Unit operations: Size reduction: Fundamentals-Methods-Preliminary breaking-Jaw crushers-Different types-Jaw and Gyratory crushers-Comparison of disintegrators-Rolls, steam stamps, gravity stamps and stamping.

**UNIT-II:** Fine grinding, wet grinding- Mechanism of tumbling mills-Rod mills, Ball mills and tube mills- Grinding pan. Dry grinding: Buhr and attrition mills-Impact mills-Jet pulverizer-Roller mills- - Tube mills-Compartment mill operation-Closed and open Circuit grinding-Modern equipment. Laws of crushing and work index.

**UNIT-III:** Size separation, screening, sizing by screens-Principles of screening-sizing-sieve scale-limits of screening-screening surfaces-types of screens-grizzlies, trammels, revolving, shaking and vibrating screens and sampling. Air sizing and dust collection: Principles of suspension in air-Gravitational separators-Internal separators – filters – washers - Electrical precipitation - Dust collecting system.

**Unit-IV: Classifiers:** Principles of settling, free settling, hindered settling-Hydraulic classifiers-Hydroseparators-Mechanical classifiers, types, construction and operation-Gravity concentration-jigging and shaking tables-Wilfley tables-Sink float separation - Film fixing - pneumatic concentration.

**UNIT-V: Concentration floatation:** Definition-Principle and application for formation & conditioning. Frothing agents and their action - Collecting agents and their action - Pulp control reagents - Dispersing agents - Deflocculates and protective colloids - Floatation machines -Operation flow sheets – performances - Floatation practice. Electrical concentration. Magnetic separation and concentration - Drum separators - Pulley separators - Ball separators - Wet magnetic separation - Magnetic flocculation and deflocculation - Principles of Electrostatic separation - Electrostatic separators.

### **Books for study and reference**

- Jain S.K. , 1986, Ore processing, Oxford and IBH publishing Co., Pvt. Ltd., New Delhi,
- R.H.Richards and C.E. Lecke,1964, Text Book of ore-dressing, McGraw Hill Book Co.,
- A. F. Taggart , 1955, Hand book of Mineral dressing, John Wiley and Sons,
- S.J.Truscott, 1954, Text book of ore-dressing, , Macmillan Co.,
- A.M.Gaudin, 1984, Principles of Mineral dressing, , Mc Graw Hill Book Co.,
- Gilchrist , 1967, Extractive Metallurgy, Wiley Eastern, New Delhi,
- Gilchrist, 1981, Extraction Metallurgy, 2<sup>nd</sup> Ed. Pergamon press, London,

## **IGYO 84 Optional – I FIELD GEOLOGY**

**Objective:** The paper aims to understand the field essentials like understating a map, the basic equipments, traversing and field markings

**UNIT- I:** Previous Literature and Maps, Destruction of Rocks, Physiography, Topographic Expressions and Relief, Inliers and Outliers, Soils and Vegetation, Requirements for the Field, Some Field Suggestions and Precautions.

**UNIT-II:** Basic equipment, Additional requirements, Supplementary supplies, Special requirements, Optional, For mapping on aerial Photographs. Geological Hammers, Pocket and Hand Lenses, Hydrochloric Acid, Streak Plate, Pocket Knife, Measuring Tapes and Scales, Haversack or Rucksack, Mohs scale of Hardness, Cold Chisel, Protractors, Pocket Calculator, Cameras, Care and Upkeep of Instruments.

**UNIT-III:** The Compass and Its Uses, Dip of the Compass Needle, Magnetic Declination, Clinometer, Bearing and Reading Directions, Measuring Attitudes, Handling of the Compass, Finding Direction without a Compass.

**UNIT- IV:** Base Maps, Scale of Maps, Direction of Relief, Latitudes and Longitudes, Map Grids Measurement of the Map Areas, Mounding and Folding of Field Maps, Marking on Maps.

**UNIT-V:** The Notebook, Notes, Checklist for Notes, Writing Materials, Field Sketches and Drawings, Field Photographs. Trimming of Hand Specimens, Fossil Specimens, Mineral Specimens, Samples and Samplings, Numbering and Labelling of Specimens, Packing and Storage.

### **BOOKS FOR REFERENCE**

- Davis, G.R. 1984, Structural Geology of Rocks and Region, John Wiley
- H.W. Fairborn, 1949, Structural petrology of deformed rocks, John Wiley and sons
- John Suppe 1985, Principles of Structural Geology, prentice Hall publications
- Price N.J., and Cosgrove, J.W. 1990. Analysis of Geological structures, Cambridge Univ. Press
- Ramsay, J.G. and Huber,M.I., 1987, Modern structural Geology Vol, I and II Academic press
- Robert R.Compton, 1962, Manual of field geology, John Wiley and sons.

## **PRACTICAL –VIII**

### **IGYP 85-MINERALOGY, CRYSTALLOGRAPHY & MINERAL OPTICS & ORE PETROLOGY**

#### **Megascope and microscopic study of important rock forming group of minerals:**

Calculation of molecular and structural formulae of some important minerals. Determination of optical properties of minerals. Systematic preparation of thin section and polished ore section in the departmental laboratory. Birefringence of minerals - using Berek compensator. Pleochroic scheme, 2V by Mallard's method, Sign determination. Determination of plagioclase orientation in thin section and its Anorthite content from extinction angle measurements.

Optic signs of uniaxial and biaxial minerals. Determination of cell dimensions and identification of minerals from X-Ray Diffractogram.

#### **Crystallography**

Goniometric measurement of interfacial angles –stereographic projections of crystals – Calculation of axial ratios, miller indices of faces, application of Weiss zone law, Tangent relationships, Napier's rule, law of anharmonic ratio and equation to normal.

#### **Ore Petrology**

Study of mineralogy, texture and paragenesis of ore sections like Magnetite, Hematite, Ilmenite, Pyrite, Chalcopyrite, Sphalerite, Galena, Pyrolusite, Psilomelane, Chemical analysis of economic minerals.

### **IGYP-86 PRACTICAL-IX - MINERAL DRESSING**

Crushing and grinding Tests - Sieve analysis - Air apparatus – Elutriation - Hydraulic classifiers - Wilfley tables - Flotation methods of separation - settling tests, sink and float - Filters and driers. Separation of minerals by different methods



## **SEMESTER IX**

### **IGYT-91 ADVANCED IGNEOUS & METAMORPHIC PETROLOGY**

**UNIT-I:** Petrogenetic significances of forms, textures and structures of igneous rocks - Classification of igneous rocks - Mineralogical and chemical. Niggli and Streikeissen - IUGS-Classification -Phase-equilibrium studies of binary and ternary silicate system: Albite-Anorthite system, Albite-Anorthite-Diopside system. Anorthite-Forsterite-Silica system, Diopside – Forsterite - Silica system with reference to petrogenesis of igneous rocks - Crystallization of basaltic magma in relation to the tectonic setting. Basalt magma-Sea water interaction.

**UNIT-II:** Petrography and petrogenesis of Granites, Pegmatites, Alkaline rocks, Monomineralic rocks: Anorthosites, Dunites, Pyroxenite, Lamprophyres, Carbonatites, Charnockites and Ultramafics.

**UNIT-III:** Diversity of igneous rocks - Reaction principle - Magmatic crystallization – differentiation - assimilation. Petrographic province and variation diagrams - Plate tectonics and magmatic evolution - Trace elements in igneous rocks and their significance. Fluid inclusion studies of igneous rocks. Plate tectonics in relation to magmatism.

**UNIT-IV:** Metamorphic textures and structures and their significance. Grades, zones and Facies of metamorphism. A critical review of facies concept - Graphical representation of facies, A.C.F. and A.K.F. diagrams. Goldschmidt's mineralogical phase rule and its application - Stress and Antistress minerals. Geothermometry and Geobarometry, Fluid inclusion studies in metamorphic rocks.

**UNIT-V:** Retrograde metamorphism -Metamorphic differentiation. Metasomatism - Granitisation and Migmatites. Metamorphism in relation to magma and orogeny. Application of geochronological methods -Sm/Nd, U/Pb method. Methods of determination of metamorphic rocks. Plate tectonics in relation to metamorphism.

#### **Books for study and reference**

- Phillipotts, A, A. 1992, Igneous and Metamorphic petrology, Prentice Hall.
- Bose, M.K. 1997, Igneous petrology, World Press

- S.R.Nockolds, R.W.O.B. Knox, G.A. Chinner, 1979, petrology for students, Cambridge University Press
- Paul C.Hess, 1989, Origin of Igneous rocks, Harvard University press, Cambridge, London, England
- Anthony Hall, 1987, Igneous petrology, ELBS publishers
- W.W. Moorhouse, 1969, The study of rocks in thin sections, Harper and sons
- H.H. Hess and A. Poldervaart, 1967, Basalts, Vols, I and II, Ed., Interscience publisher
- Edwin Roedder, 1986, Fluid inclusions Publisher Mineralogical Society of America, Printed by Book Crafters, Inc. Chelsea, Michigan.
- F.J.Turner & J.Verhoogen, 1960, Igneous and Metamorphic petrology, Mc Graw Hill Book Co.,
- T.F.W.Barth, 1962, Theoretical petrology, John & Wiley and sons.
- F.J.Turner and C.M.Gilbert, 1954, Petrography H.Williams, W.H.Freeman and Co.
- H.G.S.Winkler, 1979, Petrogenesis of Metamorphic rocks, Springer Verlag Vth Edition.
- Roger Mason, 1984, Petrology of the metamorphic rocks, CBS Pub. & Distributors.
- G.W.Tyrrell, 1989, Principles of petrology, Methuren and Co., (Students ed.)
- Barker, A.J. 1989, Introduction to metamorphic textures and microstructures, Chapman and Hill.
- S.Barkar, 1983, Igneous rocks, Daniel, Prentice Hall, Englewood Cliffs, New Jersey
- Myron G. Best, 1986, Igneous and Metamorphic petrology, CBS publisher.
- E.E. Wahlstrom, 1961, Theoretical Igneous petrology, John Wiley & Sons.

## **IGYT-92 ADVANCED STRATIGRAPHY, SEDIMENTOLOGY AND MICROPALAEONTOLOGY**

**UNIT-I:** International stratigraphic code, lithostratigraphy, biostratigraphy and chrono stratigraphic units, geological , biological and physical events, their geological time. Principle and application of seismic, sequential, chemo and magneto stratigraphy.

**UNIT-II:** Origin of sediments – Classification and composition of sedimentary rocks. Textures and structures of sedimentary rocks and their environmental significance. Petrography, mineralogy and Chemistry of clastic and non clastic rocks. Mode of transport for Clastic sediments. Petrogenesis - Lithification and diagenesis. Heavy mineral zones and their provenance history. Application of trace element, rare earth element and isotope geochemistry to sedimentological problems. Graphical representation and their geological Significance.

**UNIT-III:** Environmental analysis- concept, parameters and classification of environments. Facies model and environmental reconstruction (Alluvial Environments)-shore zone environments and cyclic sequences. Sedimentation and tectonism, Concept of sedimentary model- Walther's law, genetic increments-sequences and cycles. Sedimentary facies. Sedimentary models - concepts & application. Paleocurrents and Paleogeography and its application in Basin Analysis. Application of sedimentological studies in paleoenvironmental studies.

**UNIT-IV:** Brief review of micropaleontology – classification of microfauna – Sampling methods and sample processing techniques - Bathymetric distribution of microfossils - Morphological characters and Paleoecology of Foraminifera, Radiolarians, Diatoms and Flagellates.

**UNIT-V:** Palynofossils: Separation techniques - General morphology, brief account of spores and pollens and their geological significance. Application of Micropaleontology in Geological and petroleum exploration. Environmental significance of microfossils - determination of age and correlation of palaeofacies and tectonism from microfaunal evidence.

#### **Books for study and reference**

- Roy Lindholm, 1989, A Practical Approach to Sedimentology, Allen and Unwin, USA.
- F.J.Pettijohn, 1975, Sedimentary rocks, Harper & Bros. 3<sup>rd</sup> Ed.
- G.M. Sanders, 1978, Principles of Sedimentology, Friedman, E.J. John Wiley and sons, Newyork.
- Nichols, H. G,1999, Sedimentary environments, Blackwell
- Einsele, G.1992, Sedimentary basins, Springer Verlag.
- J.P.Kennet and M.S.Srinivasan, 1951, Foraminifera, W.H.Freeman & Co.,
- M.D., Brasier, 1980, Microfossils, George Allen & Unwin, London.
- G. Bigot, 1985, Elements of micropaleontology, Graham & Trotman, London.
- Wilson, J.L, 1975, Carbonate facies in geological history, Springer Verlag, New York,
- Gary Nichols, 1999, Sedimentology and Stratigraphy, Blackwell Science Ltd., London,
- Galloway. W.C. and D.K.Hobdew, 1996, Terrigenous clastic sedimentary systems, Springer, Verlag, New York.

- Reinbeck, H.E., and Singh.J.P. 1980, Depositional sedimentary environments, Springer Verlag, New York.
- Twenhofel, W.H. 1950, Principles of sedimentation, Mc Graw Hill Book Co.,
- Folk, R.L. 1961, Petrology of Sedimentary rocks, Hemphills,
- Alex S.D. Maltman, 1994, The geological deformation of sediments, Chapman Hall,
- Devesh.K. Sinha, 2007, Micropaleontology – Application in Stratigraphy & Pale oceanography, Narosa publishing House.

## **IGYT-93 GEOLOGICAL AND GEOPHYSICAL EXPLORATIONS**

**UNIT–I:** Reconnaissance Vs detailed mapping, surface mapping; Degree of precision, choice of scales, isolation of outcrops. Sampling, general principles, methods of sampling, channel, chip, grab etc. Various drilling techniques. Sampling errors, precautions against salting.

**UNIT–II:** Topographic expression of ore bodies, physiographic relations of placer deposits, guides to channels, location of pay streaks, Physiography in relation to oxidation & enrichment. Residual ores, supergene sulphide zones; mineralogical guides: Rock alteration, nature of alteration, target rings of mineral distribution.

**UNIT–III:** Stratigraphic and lithological guides: supergene deposits, reasons for favorability, competent Vs incompetent formations. Examples of favorable formations. Fracture pattern as guides: (Structural guides): Mechanical principle of fracturing, vein patterns. Contacts and folds as guides: folds younger than the ore-folds older than ore; dislocated ore bodies. Persistence of ore in depth: probable position and shape at deeper levels pitch and changes in shape.

**UNIT–IV:** Principles, major methods, their applications and limitation. Gravity and Magnetic methods- Corrections – Fundamental principles – field procedures. Application of gravity and magnetic methods. Correlation and interpretation of data. Radiometric methods – Radioactivity and its detection, instruments-G.M. counters and Scintillometers, field methods and interpretation procedures. Principles of air borne surveys.

**UNIT-V:** Seismic methods – Elastic waves and wave propagation – Principles of reflection and refraction methods, field procedures, interpretation of results – Application in petroleum exploration. Electrical methods – Principles, self potential methods. Resistivity methods (ERI-IP) – Application in ground water exploration – electromagnetic methods – instruments

– field procedures and application and interpretation. Principles of well logging methods – application in ground water and petroleum.

### **Books for study and reference**

- M.B. Ramachandra Rao, 1975, Outlines of Geophysical prospecting ( A Manual for Geologists) Prasaranga, University of Mysore
- M.B.Dobrin, 1960, Introduction to Geophysical prospecting, , Mc Graw Hill Book Co., New Delhi
- Sharma, P.V. 1986, Geophysical methods in Geology, Elsevier.
- Stanislane, M., 1984, Introduction to Applied Geophysics, Reidel Publishers.
- Parasnis, D.S., 1975. Principles of Applied Geophysics, Chapman and Hall.
- Telford.W.M, Sheriff, R.E., Gehlot, L.P, 2001, Applied Geophysics (Second Edition) Cambridge University press.
- H.E. Mc Kinstry, 1960, Mining Geology, Asia publishing house,
- Rose, A.W.Hawks, H.E, H.E, H.E. and Webb, J.A. 1979, Geochemistry in Mineral Exploration, Academic press.
- William Lowrie, 2007, Fundamentals of Geophysics, 2<sup>nd</sup> Ed, Cambridge University press.
- Govett. G.J.S, 1983, Hand book of Exploration Geochemistry, Elsevier

## **IGYT-94 GEOCHEMICAL EXPLORATION AND ISOTOPE GEOLOGY**

**UNIT-I:** Geochemistry: Introduction, definition-aim and scope. Brief treatment of origin and abundance of elements. Distribution of elements in lithosphere of the Earth. Geochemical classification of elements. Geochemical differentiation of elements in exogenic and endogenic cycle– Chemical weathering. Geochemical classification of sediments-Resistates-Hydrozates, Oxidates, Redusates, Precipitates, Evaporates. Metamorphism as a geochemical phenomenon.

**UNIT-II:** Geochemical Exploration: Principles of geochemical exploration. Geochemistry in Mineral Exploration - Geochemical environment-Geochemical cycle – Dispersion, Mobility, Association and Distribution of elements. Methods of geochemical exploration-(a) Lithochemical prospecting (b)Hydrogeochemical prospecting (c)Biogeochemical prospecting (d) Geobotanical prospecting. Geochemical prospecting models for petroleum and natural gas; geochemical prospecting in marine environment.

**UNIT-III:** Methods of surveying and sampling –Anomalies-Anomalies in Residual overburden, leached ore outcrops, Residual soils transported and overburden. Geochemical anomalies map and interpretation of data. Geochemical trace element indicators and their significance. . Analytical techniques -Calorimetric, Flame Photometric, Atomic Absorption Spectrophotometric techniques.

**UNIT-IV:** Introduction – Basic principles of Isotope Geology – Discovery of Isotopes, Chemical properties of Isotopes, Thermodynamic properties of Isotopic compounds-Equilibrium constants, Separation of Isotopes-Physical and Chemical methods. Classification of isotopes. Relationship between radionuclides and its decay products. Unit of radioactivity measurement. Distribution of Radioactive elements in Igneous, Sedimentary and Metamorphic rocks and waters. Geochemical behavior of Uranium and Thorium. Artificial radioactive material. Nuclear energy - fission and fusion techniques.

**UNIT-V:** Geochronometry-radioactive dating techniques K-Ar, U-Pb,  $^{14}\text{C}$ . Isotope Ratio Mass Spectrometer. Fractionation of stable isotopes in Lithosphere, Hydrosphere and Atmosphere. Stable isotopes and their uses. Application of environmental isotopes.

#### **Books for study and reference**

- B.Mason, 1971, Principles of Geochemistry, John Wiley & Sons.
- Krauskopf.K.B, 1986, Introduction to geochemistry, Mc Graw Hill.
- Mason.B. and Moore.C.B. 1991, Introduction to Geochemistry, Wiley Eastern
- Kovalevskii, A.L. 1979, biogeochemical exploration for mineral deposits, Oxonian press.
- Arthur Brown low 1982, Geochemistry, Prentice Hall
- V.M.Goldschmidt, 1954, Geochemistry, Oxford University Press.
- W.S.Fyfe, 1964, Geochemistry of solids. Mc Graw Hill Book Co.
- Henry Faul, 1954,Nuclear Geology, John Wiley & Sons, New York
- Kalvero Rankama, 1954, Progress in Isotope Geology, Pergamon press, London.
- Gunture Faure.G. 198, Principles of Isotope Geology, John Wiley & Sons, New York, 2<sup>nd</sup> Ed.
- U. Aswathnarayana, 1985, Principles of Nuclear Geology, Oxonian press (P) Ltd., New Delhi.
- Rankama and Sharma, 1950, Geochemistry, University of Chicago Press
- Robert D. Nininger, D,1955,Minerals of Atomic energy, Van Nostrand Co.
- S.N. Virnave, 1999,Nuclear Geology and Atomic Mineral Resources, Bharati Bhawan Publishers & Distributors

- Faure, G. and Powell, J.L., 1972, Strontium Isotopes Geology, Springer Verlag.
- Doe, B.R, 1970, Lead Isotopes, Springer Verlag.
- Pascal, 2<sup>nd</sup> Ed. 1977, Geochemical prospecting methods, Ustrendi
- Brooks, A.R. 1972, Geobotany and Biogeochemistry in mineral exploration, Harper and Row.
- O.D. Tyagi, M. Mehira, 2006, A text book of Environmental chemistry, Anmol publications, New Delhi.
- Pooja Bhagwan, 2009, A Hand Book of Chemical Analysis, International Scientific publishers.

## **PRACTICAL-X**

### **IGYP 96-GEOEXPLORATION & GEOCHEMISTRY**

#### **GEOCHEMISTRY:**

Sample preparation for geochemical analysis. Preparation of A and B solution. Major and minor elemental analysis by using spectrophotometer, flame spectrometer and titrimetric methods.

Preparation of geochemical anomaly maps and interpretation based on statistical analysis of data. Determination of background threshold values from maps.

REE distribution patterns of igneous rocks. Problems of geological interpretation of geochemical data.

Calculation of C.I.P.W. Norm, Niggli values, Variation diagrams of Harker and Niggli. ACF, AKF diagrams.

#### **GEOPHYSICS:**

Geophysical methods-Gravity, Magnetic, Seismic methods problems and applications. Preparation of geophysical anomaly maps, Isoresistivity maps, X-ray, Sp, Neutron, Density, Sonic, Caliper, Dipmeter log, cement bond log in oil wells and water wells.

**PRACTICAL-XI**  
**IGYP 97-PETOLOGY, SEDOMENTOLOGY &**  
**MICROPALAEONTOLOGY**

**PETROLOGY:**

Preparation of thin sections of rocks - Megascopic and Microscopic identification - Texture, Structure and Petrogenesis.

***Igneous Rocks:***

1. Charnockite, Granite, Rhyolite and Dacite
2. Syenite, Nephelene Syenite, Trachyte, Diorite, Andesite
3. Anorthosite, Gabbro, Pyroxenite, Dunite, Basalt

***Metamorphic Rocks:***

4. Granitic gneiss, Hornblende Biotite Gneiss, Quartzite, Mica Schist, Eclogite

***Sedimentary Rocks:***

5. Conglomerate, Breccia, Sandstone, Arkose, Grit, Shale, Laterite, Limestone, Oolitic limestone,

**SEDIMENTOLOGY:**

Mechanical analysis of sediments. Statistical analyses of grain size data. Plotting of size analysis data. Determination of roundness and sphericity of grains. Separation of heavy minerals and study of their microscopic characteristics.

**MICROPALAEONTOLOGY:**

Methods of separation of micro fossils. Identification of selected taxa of microfossil groups under the stereo binocular microscope and observation of morphological characters of some particular species. Benthic and Planktonic foraminifera – Interpretation of environmental significances.



## **SEMESTER X**

### **IGYT-101 ADVANCED HYDROGEOLOGY, REMOTE SENSING & GIS**

**UNIT-I:** Hydrostratigraphic units - pumping test analysis and determination of hydrological parameters of aquifers -well inventory studies-water budgeting and management of groundwater- Recharge-artificial and natural-factors controlling recharge. Introduction to groundwater modeling.

**UNIT-II:** Methods of groundwater surface and subsurface prospecting -- Geophysical resistivity method, Bore well design and development - saltwater intrusion – Stable isotopes in water cycle – relationship between  $^{18}\text{O}/^{16}\text{O}$  and  $^2\text{H}/^1\text{H}$  in natural waters. Isotope effect in precipitation- continental, amount, seasonal, temperature, latitude and altitude. Applications of Tritium,  $^{14}\text{C}$  and  $^{13}\text{C}$  isotopes in hydrogeology.

**UNIT-III:** Active and Passive Remote sensing -Basic principles of Microwave and Thermal Remote Sensing - Principles of Digital image processing – Image enhancement techniques – Image contrast stretching -Image Filtering -Principal Component Analysis. Image classification (Supervised and unsupervised classification). Applications of remote sensing in geological studies.

**UNIT-IV:** Geographic information system (GIS) – Concept and types of map projection. Raster and vector data models, DEM / DTM model, Spaghetti model. Advanced data models – Grid model, TIN model, Network model

**UNIT-V:** Geographic information system -Spatial analysis – logic operations, general arithmetic operations, statistical operations and geometrical operations. Query and report generation from attribute data. Overlay analysis-raster & vector, Buffer analysis - Reclassification - Spatial interpolation. Web GIS – advantages and limitations.

#### **Books for study and reference**

- C.P.Tolman, 1998, Ground water, Mc Graw Hill Book Co.
- Howman Bower, 1965, Ground water Hydrology, Mc Graw Hill Book Co.
- Rogar, J.M.Deweist, 1965, Geohydrology, John Wiley and sons.
- K.R.Karanth, 1986, Hydrology, S.R.Technico Book house, Ashok Raj path, Patna.

- K.R.Karant, 1998, Groundwater management, S.R.Technico Book house, Ashok Raj path, Patna.
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- P.K. Kitanidis, 1997, Introduction to Geostatistics Applications in Hydrogeology Cambridge University press.
- E.M. Wilson, 1990, Engineering Hydrology, 4<sup>th</sup> Ed, ELBS Publications.
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- Michael Kennedy 2002, The Global Positioning System, GIS, An Introduction, Taylor & Francis.
- Robert P. Bukata, John.H. Jerone etc, 1995, optical properties & Remote sensing of In Land and coastal waters, CRC Publications.
- A.B. Bhatt, 1994, Aerial photography and Remote sensing -An Introduction, Bishen singh Mahendrapal singh, Dehradun.
- Prithvish Nag and Smita Senguptha, 2008, Introduction to Geographical Information system concept publications.
- Dr. B.C. Panda., 2009, Remote Sensing principle and applications, Viva books.
- James B Cambell, 2006, Introduction to remote sensing, Taylor & Francis.
- Shatab Fazal, 2007, Geographic Information system Terminology, New Age Publications.
- N.M. Naidu, 2009, Geoinformatics & Geostatistics, SBS publications & Distributions.
- George Joseph, 2005, Fundamentals of Remote Sensing, University Press (India) Pvt ltd, 2<sup>nd</sup> Edition

## **IGYT 102 MEDICAL GEOLOGY**

### **OBJECTIVE:**

The geochemistry of the environments have a marked influence on their health, giving rise to diseases that affect millions of people This paper aims to expose the students on the interaction of Human beings with the geochemistry of the earth environment.

### **Unit-1 EARTH ENVIRONMENT**

General characteristics of tropical , subtropical environments, arid zone, seasonally dry tropics and sub-tropics, humid tropics, and sub-tropics zone and mountainous zone. Rock weathering and soil formation, weathering of mineralized terrains, weathering profiles. Weathering and formation of secondary minerals. Chemistry of weathering of ultra-basic rocks.

### **Unit-2 MEDICAL GEOLOGY AND SOURCES OF UPTAKE**

Medical Geology- Perspectives and Prospects, Public Health and Geological Processes: An Overview of a Fundamental Relationship. Environmental Biology-Natural Distribution and Abundance of Elements, Anthropogenic Sources, Uptake of Elements on Chemical and Biological Perspective and its functions, Geological Impacts on Nutrition.

### **Unit-3 PATHWAY AND EXPOSURE OF HAZARDOUS PARAMETERS**

Pathways and Exposure- Volcanic Emissions and Health, Radon in Air and Water, Arsenic in Groundwater and the Environment. WHO and BIS Standards for drinking water. Fluoride in Natural Waters, soils, sediments, plants. Fluorides and health: Bioavailability of fluoride, Dental fluorosis, Skeletal fluorosis, Dental fluorosis in India, source, nature, cause and extent. Water Hardness and Health Effects, Geochemical basis for tropical endomyocardial fibrosis (EMF), Effect of water hardness on urinary stone formation (urolithiasis), Types of stones: Calcium oxalate, Calcium phosphate, Uric acid, Magnesium ammonium phosphate stones, Cysteine.

### **Unit-4 MEDICAL GEOLOGY OF IODINE, NITROGEN AND SELENIUM**

Iodine and health: The iodine cycle in the environment, Iodine in drinking water, Iodine in food, Iodine Deficiency Disorders (IDD), Endemic cretinism, Goitrogens .The nitrogen cycle, Nitrate as fertilizers and environment, Nitrogen loading in rice fields, Nitrates from human and animal wastes, Nitrates and health, Nitrates and Methemoglobinemia, Nitrates and cancer. Bioavailability of Elements in Soil, Selenium Deficiency and Toxicity in the Environment, Soils and Iodine Deficiency, Natural Aerosolic Mineral Dusts and Human Health, Animals and Medical Geology. The Impact of Micronutrient Deficiencies in Agricultural Soils and Crops on the Nutritional Health of Humans.

### **Unit-5 ENVIRONMENTAL TOXICOLOGY AND MINERALOGY OF BONES**

Environmental Toxicology, Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Speciation of Trace Elements. Techniques and Tools- GIS in Human Health Studies, Investigating Vector-Borne and Zoonotic Diseases with Remote Sensing and GIS. Mineralogy of Bones, Inorganic and Organic Geochemistry Techniques, Histochemical and Microprobe Analysis in Medical Geology.

### **Books for study and reference**

- C.B. Dissanayake and R.Chandrajith (2009). Introduction to Medical Geology, Springer, London
- H.Catherine, W.Skinner, Antony R. Berger(2003). Geology and Health: Closing gap, Oxford Univ. press, New York.
- Iosif F.Volfson (2010). Medical Geology: Current Status and Perspectives, 2010. , Russian Geological Society (ROSGEO) Publisher. Moscow.
- K.S. Valdiya (2004). Geology, environment, Society, University press(India), Hyderabad.

- Lawrence K. Wang, Jiaping Paul Chen, Yung-Tse Hung, Nazih K. Shammam (2009). Heavy Metals in the Environment, CRS Press, Taylor & Francis Group, Boca Raton, FL
- M.M. Komarica, (2004) Medical Geology, Vol.2, Effects of geological environment on Human health, Elsevier, U.K.
- Oile Selinus, B. Elsevier(2003). Essentials of Medical Geology (2005), Acamedica Press., U.K.
- Oile Selinus, B. Finkleman, R.B., A. Jose (2010) Medical Geology- Regional synthesis(2010), Springer, London.
- Scott S. Olson, (1999) International Environmental Standards Handbook, CRC Press, London.
- William N. Rom, (2012). Environmental Policy and Public Health - Air Pollution, Global Climate Change, and Wilderness, by John Wiley & Sons, Inc. Published by Jossey-Bass A Wiley Imprint.

**INTERNAL OPTION**  
**(For students of M.SC Geology Integrated)**

**Optional –III**

**IGYO 103 ENVIRONMENTAL GEOSCIENCES & DISASTER  
MANAGEMENT**

**UNIT-I:** Principles of environmental geology-ecological perspective-problems of environment- global and Indian perspective. Environmental degradation, Components of environment-atmosphere, hydrosphere, lithosphere and biosphere-their interaction and related problems. Global warming and Climate change.

**UNIT-II:** Introduction to Natural Hazards: Earthquakes and related phenomena, Tsunami, Volcanic Activity, Rivers and Flooding, Slope Processes, Landslides, and Subsidence, Coastal Processes. Environmental Pollution - definition, causes and concepts, sources of pollution-nature of pollutants-pollution monitoring and pollution reduction – air pollution, water pollution, soil/land pollution, marine pollution, thermal pollution, nuclear hazards.

**UNIT-III:** Methods of mining- Impact of mining, Impact identification of mining operation, waste minimization and utilization. Environmental management of mines, Wasteland reclamation. Environmental legislations: laws related to water, air, forest conservation and other acts. Hazard and Disaster: Definition and terminologies – Classification, Concept of Disaster Management- Comprehensive Disaster Management Plan, Elements of Disaster. Environmental Impact Assessment (EIA). Environmental Education. Environmental Ethics. Solid waste management: causes, effect and control, urban & industrial waste.

## **UNIT IV DISASTER MANAGEMENT AND PHASES OF CLASSIFICATION**

Introduction Disaster Management - Distinguishing between an emergency and a disaster situation, Types of natural and non-natural disasters. Disaster Management Cycle – Phase I - Mitigation- strategies, Disaster Management cycle, Hazard identification and vulnerability analysis, Mitigation strategies or measures, Disaster Mitigation and Infrastructure, Disaster and Development. Disaster Management Cycle – Phase II: Preparedness, Disaster Preparedness, Disaster Risk Reduction (DRR). Phases III and IV: Response and Recovery, Aims of disaster response, Disaster Response Activities, Modern and traditional responses to disasters, Modern methods of disaster response, Disaster Recovery, The Recovery Plan, Disasters as opportunities for development initiatives.

## **UNIT V DISASTER MANAGEMENT AND OVERPROTECTIVE TECHNIQUES**

Education and Public Awareness –Community-based Initiatives, Stakeholders’ Roles and Responsibilities, Government, Non-Government Organisations. Pre-Disaster Mitigation Plan Personnel Training, Volunteer Assistance, School-based Programmes, Hazardous Materials, Ways of storing and safely handling hazardous materials. The Role of Technology in Disaster Management: Emergency Management Systems (EMS), EMS and the Disaster Management Cycle. Geographic Information Systems (GIS) and Disaster Management: GIS Applications, GIS and the Disaster Management Cycle, Remote Sensing Satellites, Remote Sensing in Disaster Management, Advantages of Remote Sensing, and Challenges faced using Remote Sensing GIS and Emergency Shelters, GIS and Distribution of Relief, GIS and Data Gathering, Advantages of GIS, Challenges of using GIS in Disaster Management. Global Positioning System (GPS) and Disaster Management: Application of GPS to Disaster Management.

### **Books for study and reference**

- Harsh .K. Gupta (2003), Disaster Management, University Press
- Ignacimuthu.S, 1998, Environmental Awareness and Protection, Phoenix Publishing House Pvt. Ltd., New Delhi
- Keller.E.A, 1978, Environmental Geology, A. Charles E.Merrill Pub. Co., A. Bell & Howell Co., London, 4<sup>th</sup> Ed.
- Lawrence Lundgren, 1986, Environmental Geology, Prentice-Hall.
- R.B Singh(Ed) (2000) Disaster Management, Rawat Publication, New Delhi.

- Strahler.A.N and Strahler.A.N, A.H.,1973, Environmental Geosciences, Wiley International Edition.
- Thomas D. Schneid and Larry Collins (2001), Disaster management and preparedness: Occupational safety and health guide series, CRC Press
- Upendra Kumar Sinha, 1986, Ganga-Pollution & Health Hazard Inter-India publication, New Delhi.
- Valdiya, K.S., 1987, Environmental Geology, Indian context, Tata Mc Graw Hill. Bombay.

### **INTERNAL OPTION**

**(For students of M.SC Applied geology Integrated)**

### **OPTIONAL –IV**

### **IGYO 104 – GEOLOGICAL INSTRUMENTATION & ANALYTICAL TECHNIQUES**

**Unit I:** Rock sample collection, Sediment sample collection, Water sample collection, samples for geochemical study. Collection of samples from exposed materials. Samples acquired from drilling operations. Sampling apparatus-Scraper or drag bucket type of sampler, coring tube samplers, Snapper or grab bucket samplers, Rod samplers, Chambered weight samplers, Ripple mark samplers, Sediment traps.

**Unit II:** Sample preparation for thin section of hard rocks and sediments. Preparation of Polished ore and thin section for petrographic study. Sample etching, staining and modal count techniques. Techniques of photomicrography. Thin section preparation of heavy minerals and identification.

**Unit III:** Separation of minerals - Magnetic separation - Dielectric separation of mineral particles. Electrostatic separation - panning- rolling, sieving and hand picking.

**Unit IV:** Determination of major and minor elements. Principles of geological application of Cathodoluminescence, Atomic absorption spectrophotometry, inductively coupled plasma-atomic emission spectrometry.

**Unit V:** X-ray fluorescence spectrometry, Scanning and Transmission electron microscopy, Micro probe analysis. X-ray Diffractometry, Thermal ionization and gas source mass spectrometry. Principles of Chromatograph.

#### **Books Recommended**

Deer, W.A., Howie, R.A., and Zussman, J. Longman; 1996 The Rock forming minerals

John Wiley, Klein, C and Hurlbut, Jr. C.S. John Wiley, 1983 Manual of Mineralogy,  
Putnis, Andrew, 1992. Introduction to Mineral Sciences, Cambridge University press,  
Spear, F.S., .1993, Mineralogical phase Equilibria and pressure-Temperature-Time paths.  
Mineralogical Society of America Publisher  
Phillips, W.M.R. and Griffen, D.T. 1986, Optical Mineralogy, CBS Ed Laboratory Handbook  
of Hutchinson, C.S., 1974, Petrographic techniques, John Wiley.  
B.K.Sharma, 1998, Instrumental methods of chemical analysis, GOEL, Publishing House,  
Meerus.  
Galen.W.Ewing, 1975, Instrumental methods of chemical analysis, 4<sup>th</sup> Ed. International student  
Ed. Mc Graw Hill, Book Co.,

## **PRACTICAL – XIII**

### **IGYP 105-HYDROGEOLOGY, REMOTE SENSING AND GIS**

#### **Hydrogeology**

- a. Pumping test:* time - drawdown and time - recovery tests and evaluation of aquifer parameters. Processing of the pumping test data by Cooper, Theis, Jacob and Walton methods.
- b. Geophysical methods:* Electrical resistivity sounding for delineation of fresh and saline aquifers. Identification of favorable zones for groundwater and design of well. Interpretation of well logs, resistivity, SP. Estimation of TDS using resistivity and SP logs.
- c. Chemical analysis:* Chemical analysis of major dissolved constituent of groundwater and graphical representation. Interpretation of quality for various uses. Exercises on groundwater exploration using remote sensing techniques.

#### **Aerial Photography**

- a) Drainage analysis – pattern reorganization and extracting lithology and structural control. Drainage density, stream frequency and Stream ordering.
- b) Lithology determination using photo recognition elements.



### **Remote Sensing:**

- a) Preparation and interpretation of coastal land forms, fluvial landforms, lineaments and land use map.
- b) Demarcation of groundwater potential zone, coastal vulnerability, hazard zone mapping and land use change detection

### **Image Processing:**

- f. Band ratios, filters, georeferencing/ rectification & principal component analysis
- g. Information extraction and mosaic
- h. Image enhancement techniques – spatial – spectral – radiometric corrections
- i. Supervised and Unsupervised classification
- j. View images and Map composer

### **GIS:**

- a. Calculation of total area of the topographic map
- b. Calculation of per degree distance of latitude and longitude
- c. Digitization of points, lines and polygon features
- d. Creation of table structure
- e. Buffer analysis of point, line and polygon features
- f. Map layout

## **IGYO -106 DISSERTATIONS AND VIVA –VOCE**

Each student in the beginning of X –semester should choose a topic of dissertation in the field related to their Industrial / institutional training and work with a guide, who one among the teacher, in the department. At the end of the semester should submit a dissertation not exceeding **150** pages inclusive of tables and illustrations. Evaluation will be made on the basis of merit of the dissertation and performance in the viva-voce.