# DEPARTMENT OF GEOLOGY

## SALEM-636 011

**DEGREE OF MASTER OF PHILOSOPHY**

**M.Phil.,**

**GEOLOGY**

[Choice Based Credit System (CBCS)]

Syllabus for University Department

# OBE -SYLLABUS

**(Effective from the Academic year 2018-2019 onwards and thereafter)**

# PERIYAR UNIVERSITY
## DEGREE OF MASTER OF PHILOSOPHY (M.Phil.,)
## DEPARTMENT OF GEOLOGY

## REGULATIONS

**(Effective from the academic year 2018-2019 0nwards)**

The Department of Geology, Periyar University offers a full time one year M.Phil., course in Geology. The course of the study is suitable for those candidates want to increase their research knowledge for accelerating their career by exploring and acquire a critical understanding in the applied geology. The study is designed to provide in depth knowledge, information, and techniques. The main aim and outcome of the course as follows;

### Program Educational Objectives (PEOs)

PEO1 To make critical and independent inquiry in the geosciences is included, the ability to gather and evaluate peer-reviewed literature; identify a research question; design and conduct a research plan to collect laboratory and/or field data; and interpret research results.

PEO2 To Demonstrate competence in fundamental geological skills including, minerals, rock and soil identification; interpretation of topographic maps, geologic maps, and various forms of imagery; construction of geologic maps and cross sections; three-dimensional conceptualization; and collection of organized field and laboratory data.

PEO3 To develop students to make decisions on issues of local and global environmental significance based on an understanding of the interrelationships between humans and natural Earth systems.

PEO4 To equip students with the necessary analytical skills in research to tackle complex geoscientific issues and challenges at national and/or regional levels.

PEO5 To provide a forum for the exchange of research output through projects, theses, seminars, conferences and publications.

### Program Outcomes (POs)

PO1 Students will exhibit timely progress in developing their program of study in the MS program during the first year.

PO2 Students are expected to demonstrate a basic level of competency in the general field of geology and in the subject area of their research.

PO3 Students will be able to demonstrate competence in oral and written communication skills including the ability to write and present independent research, write research proposals, and the ability to read and critically evaluate relevant geological literature.

PO4 Students will be able to complete research in their field of study, including the testing of a hypothesis or answering a specific scientific question or questions formulated in conjunction with the advisor and committee.

PO5 Students will be able to demonstrate appropriate quantitative skills in their sub-discipline.

**Program Specific Outcomes (PSOs)**

PSO1 Apply fundamental geological principles and concepts in theoretical, practical and vocational situations.

PSO2 Solve geological problems using logical scientific methods and creative thinking

PSO3 Synthesize geological data on a range of spatial and temporal scales to make interpretations that allow for scientific uncertainty.

PSO4 Communicate geological information concisely and accurately using written, visual, and verbal means appropriate to the situation.

PSO5 Employ new and established technologies to collect and interpret geological data, recognizing their strengths and limitations.

PSO6 Acquire geological knowledge and expertise from a range of sources in a variety of situations.

PSO7 Appreciate international perspectives on geoscience and recognize the importance of global standards for collecting and reporting geological data.

## 1. Eligibility

Candidates who have qualified for Post Graduate Degree of this University or any other University recognized by the Syndicate as equivalent thereto shall be eligible to register for the Degree of Master of Philosophy (M.Phil.,) in their respective subject and undergo the prescribed course of study in an approved institution or department of this University.

Candidates who have qualified their postgraduate degree on or after 1st January 1991 shall be required to have obtained a minimum of 55% of marks in their respective postgraduate degree to become eligible to register for the degree of the Master of Philosophy (M.Phil.,) and undergo the prescribed course of study in an approved institution or department of this University. For the candidates belonging to SC/ST community and those who have qualified for the Master's degree before 01.01.1991 the minimum eligibility marks shall be 50% in their Master's Degree.

## 2. Duration

The duration of the M.Phil., course shall extend over a period of one year from the commencement of the course.

**3. Course of the study**

The course of study for the degree shall consist of (a) Part –I comprising three written papers according to the syllabus prescribed from time to time; and (b) Part- II Dissertation.

Part-I shall consist of paper – I Research Methodology and paper – II and advanced paper on the main subject. There shall also be third paper which shall be the Core paper relating to the proposed Dissertation conducted internally by the College/Departments.

**4. Scheme of the examination**

Part – I Written Examination: Paper I, II & III

The examination of the paper I, II & III shall be held at the end of the six months. The duration of each paper shall be 3 hours.

4.1 The allotment of Marks for theory, internal, external, Dissertation and Viva voce are as follows.

(i) Theory Papers,
Internal: 25 Marks
External: 75 Marks Total Marks =100

(ii) Project Dissertation
Dissertation: 150 Marks
Viva Voce: 50 Marks Total Marks =200

4.2 The following procedure to be adapted to award internal mark.

| | |
|---|---|
| i) Seminar | : 10 marks. |
| ii) Test | : 10 Marks |
| iii) Attendance | : 05 Marks |
| | --- |
| | 25 Marks |
| | --- |

4.3 The following credits are allotted to the theory Papers and Project. Credit for theory Papers.

Part – I
Paper – I ---------- 1x 4 = 4 Credits
Paper – II ---------- 1x 4 = 4 Credits
Paper – III ---------- 1x 4 = 4 Credits
(Guide Paper)

Part – II

Project –Dissertation and Viva voce = 12 Credits
(Dissertation: 8 Credits; Viva voce: 4 Credits).

4.4 The Viva-Voce to be conducted with the following Members.

i) HOD - Member of the Viva Board.
ii) Guide - Chairman of the Viva Board.
iii) External examiner from another University area – Member of the Viva board.

4.5 The examiners will be appointed from the panel for four names of each paper (I and II) submitted by the College/Department concerned. If one examiner awards a pass mark and the other awards fail mark then the paper will be valued by a third examiner whose award of marks will be final.

4.6 The Paper III (Guide Paper) will be commonly conducted by the University and its affiliated colleges along with the papers I & II.

4.7 The respective research guide should send two sets of question papers for paper -III along with the syllabus to the University at the simulated date.

4.8 Double valuation procedure adopted for the paper III. by respective guide and the 2nd valuation by the external examiner, preferably the Viva – Voce examiner.

4.9 The following question paper pattern will be adopted.

Part - A 5 x 5 = (25Marks)
(One question from each unit with either or type)
Part - B 5 x 10 = (50Marks)
(One question from each unit with either or type)

**Part – II Dissertation**

The broad area of research shall be intimated within one month after the completion of the written examination. Upon satisfactory completion of course work, M.Phil. Scholars shall undertake research work and produce a draft dissertation. Prior to submission of the dissertation, the students shall make pre-M.Phil., presentation in the department that may be open to all faculty members and research scholars, for getting feedback and comments, which may be suitably incorporated into the draft dissertation under the advice of the supervisor. Candidates shall submit the Dissertation to the University through the supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department/Principal at the time of submitting the dissertation.

Submission or resubmission of the Dissertation will be allowed twice a year. On receipt of satisfactory evaluation reports. M.Phil., Scholars shall undergo a Viva voice examination which is to the openly defended.

**5. Passing Minimum**

A candidate shall be declared to have passed Part – I of the examination if he /she secure not less than 50% of the marks in each paper including paper – III.
A candidate shall be declared to have passed Part – II of the examination if his/her dissertation is at least.

All other candidates shall be declared to have failed in the said examinations.

**6. Restriction in Number of Chances**

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commencement of the course.

**7. Conferment of Degree**

No candidate shall be eligible for conferment of the M.Phil., degree unless he/she is declared to have passed the part of the examination as per the M.Phil., Regulations-2020.

**8. Procedure for Admission**

All departments in the University and Colleges/Institutions affiliated to the University shall admit M.Phil., students through an Entrance Test. Those qualified UGC/CSIR (JRF) Examination/SLET/GATE/teacher fellowship holder are exempted from entrance test. It shall be followed by an interview to be organized by the school/Department/Institution/University as the case may be.

Only the predetermined number of students may be admitted to the M.Phil., programme.

While granting admission to students to M.Phil., Programmes. The department/ Institute/ School will pay due attention to the National/State Reservation Policy. Any event if sufficient member of candidates are not category.

**9. Qualifications for A Supervisor**

No teacher shall be recognized as a Supervisor unless he possesses Ph.D., degree or two years of PG teaching experience after qualifying for M.Phil., or M.Litt., Degree. Only the postgraduate departments of affiliated college and departments of the University will be recognized for conducting the M.Phil., Course, provided however, the syndicate shall have the power to decide any other institutions of higher learning / research within the University area for conducting the M.Phil., Course on merits.

**10. Eligibility for Part-time**

(i) Technical Staff/ Research Assistant working in the University departments.

(ii) Teacher candidates working in the Polytechnics approved by the Director of Technical Education or in Higher Secondary Schools and High Schools/Schools approved by State Board or Central Board of Secondary Education or Educational Institutions of IAF (within Periyar University area), a minimum of 55% of Marks is prescribed, provided that for the candidates belonging to SC/ST community a concession of 5% marks will be given in the minimum eligibility marks prescribed.

**11. Duration**

The course of study shall extend over a period of one year for full-time /part-time two years from the commencement of the course. The examinations for Part –I shall be taken at the end of the 6 months for full-time/ first year part time and Part –II Dissertation at the end of the second year.

**12. Scheme of the Examination**

The Regulations governing the full-time M.Phil., Course with regard to the course of study, scheme of examination passing minimum, etc., and qualifications of guide conducting the M.Phil.,. Course shall apply to part-time candidates also.

**13. Restriction in Number of Chances**

No candidate shall be permitted to reappear for the written examination in any paper for more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of two years for full-time four years for part-time from the date of commencement of the course.

## Syllabus for M.Phil., Applied Geology

## PAPER – I

## 18MPAG01 RESEARCH METHODOLOGY

**Course Objectives**

- To get an idea on review of literature
- To apply to solving scientific written papers and thesis.
- To emphasis computer application in scientific research.
- To understand the different sampling techniques.
- To understand the applications of Remote Sensing in different fields of Geological exploration.

**Course Outcome**

- To understand concepts of research work.
- To know about conceptual and contemporary methods of research
- To formulate the research hypothesis and methodology.
- To identify the different research problem.
- To evaluate the different working principles of different geological instruments and understand the importance of data analysis tools.

**Unit I**

Importance and need for Research Ethics and Scientific Research, Formulation of Hypothesis, Identification of Problem – Literature Survey, Reference collection, Use of Libraries and Information Retrieval systems, Internet Browsing – assessing the current status- International Standard book Number (ISBN) - International Standard Serial Number (ISSN) – Discussion in the Workshop, Symposium, Conference and Seminar.

**Unit II**

Scientific writing – Characteristics. Logical format for writing Papers, Dissertation and Thesis and. Essential features of Title, Abstract, Introduction, Literature Review, Materials and Methods, Result and Discussion and Conclusion. Effective Illustration –Tables, Charts and Figures. Reference style. Presenting Scientific - Type of Teaching Skills - Evaluation of Teaching Skills – Pedagogy Technology.

**Unit III**

Computer application in scientific research-understanding of MS-Office and its uses in project documentation, presentation and analysis of data, Standardization of Data – Plagiarism in Scientific Writing - Papers-Synopsis writing –Multimedia techniques in paper presentation – Impact Factor – Scopus Index - Science Citation Index – Research Gate - Shodhganga.

**Unit IV**

Sampling techniques to Geological study- Geochemical analysis –classical and rapid analytical methods-AAs, ICP-MS-Principles, Instrumentation and Applications-Mineral identification techniques. Water sample collection – Water analysis –major and trace elements and their extraction procedures-Application of Geophysical Resistivity survey in Groundwater and Mineral

resource exploration - Size and shape determination of grains in Clastic rocks – Placer Deposits.

**Unit V**

Application of Remote sensing in resource mapping –Geophysical techniques in mineral exploration –Geochemical methods, principles and its application – Sedimentology facies analysis and its application-Application of Micropaleontology and Stratigraphy in Petroleum Exploration.

**Text / Reference Book**


1. Kothari C.R. (1990) - Research methodology, methods and techniques, New Age Lmt Publishers.
2. Dana, E.S.,(1955),Text book of Mineralogy, John Wiley., Deer
3. Gupta R.P. (2005),Remote Sensing in Geology, Springer Verlag Edition
4. Jonathan Anderson et.al. ,(1970).-Thesis and Assignment Writing 0-Wiley Eastern Ltd., New Delhi.
5. Jones R.w. (1996). Micropaleonotology in Petroleum Exploration, Caarendon Press, Oxford
6. Karanth .K.R. (1987)Grounwater Assessment and Management, Tata McGraw Hill, New Delhi.
7. Lillisand Kiefer R.W., (2000), Remote Sensing and Image Interpretation John Wiley SMS, New York.
8. Maeve O' Connon R. and Peter Woolford,(1976).-Writing Scientific Papers in English
9. John F.Koegel Buford (2005).-Twelfth Edtion-Pearson Education-Multimedia Communications – Directions & Systems
10. Parsons,C.J. (1973)-Thesis and Project work –Allen and Unwin Ltd.,London
11. Pettijohn,F.J., (1975)Sedimentary rocks Harper an drow.
12. Todd.D.K. (2003).Groundwater Hydrology, John Wiley and Sons, New York.


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

**PAPER II**

## 18MPAG02 ANALYTICAL AND INSTRUMENTATION TECHNIQUES

**Course objectives**

- To understand the microscopic observation of rocks and minerals' thin sections.
- To assess the paleontological application and methods of sampling.
- For emphasis the sedimentary environmental modeling.
- To understand the sampling methods and groundwater exploration.
- To understand the remote sensing and GIS applications.

**Course Outcome**

- To evaluate the optical properties rocks and minerals.
- Analytical ability on Foraminifera and nano-fossils.
- Knowledge and skill in sedimentary environmental modeling.
- To get knowledge on field investigation of samples.
- Software knowledge on remote sensing and GIS.

**Unit I**

Petrological microscope, Ore microscope and Scanning electron microscope - Preparation of thin section - Preparation of rock powder for chemical analysis Classification of Minerals - Physical properties of mineral, Optical properties of mineral – Processing of Minerals and Ore Formation - Isomorphism and Polymorphism – structure of silicates – Transmitted polariezed light microscopy and optical properties of uniaxial and Biaxial Minerals; Biaxial interference figures and their optic sign – Acute bisectrix figure – obtuse bisectrix figure – optic axis figure flash figure – cystal orientation – extinction angle – sign of elongation.

**Unit II**

Historical development, current and future trends in Marine Micropaleontology. Sampling methods, processing techniques, separation and illustration of microfossils. Foraminifera: Systematic position, test morphology, classification, ecology and paleoecology and application of foraminifera in paleodeptth, paleotemperature estimation of Ostracodes, Calcareous Nannofossils, Radiolarian, and Conodonts. Role of Micropaleontology in petroleum exploration.

**Unit III**

Concepts of sedimentary environmental modeling, cycles and completeness of sedimentary record correlation of sedimentary sequences, modern methods in paleo enviromental reconstruction and Hydrocarbon exploration – Heavy mineral separation methods - Basic concept and techniques of X-Ray Diffraction (XRD). X-Ray Fluorescence (XRF) and Differential Thermal Analysis (DTA).

**Unit IV**

Sampling methods and principles - Types of sampling, sampling interval - Quality of Ground Water – physical, chemical and Biological constituents of Groundwater - Flame photometer and UV spectrometer: Basic principles, Parts and operation and mechanism - Groundwater in Crystalline and Sedimentary systems- Piezometric tests- Pumping tests - Basin yield- Sea water intrusion- Sources of groundwater contamination- Groundwater and Economic mineralization - Groundwater depletion and remedial measures.

**Unit V**

Introduction to Digital Photogrammetry - DEM and its Geological Applications Satellite Remote Sensing –Interaction with EMR - Geological applications of satellite data introduction to digital Image processing - Fundamentals of GIS. Vector data model: raster data model - Buffering. Overlay analysis – GIS applications for Geological studies.

**Text /Reference Book**


1. Dana,E.S.,(1955),Text book of Mineralogy, John Wiley., Deer,
2. Francis Rouessac and Annick Rouessac., (2007), Chemical Analysis (Modern Instrumentation Methods and Techniques) John Wiley & sons, 574p.,
3. Bathurst,R.G.C., (1972) Carbonates sediments and their diagenesis. ELBS Pubications.
4. Benhardsen T. (2002) Geographic Information Systems: An Introduction, John Wiley Sons, New York.,
5. Dickin,A.P., (1995) Radiogenic Isotope Geology.
6. Drury S.A. (1993)Image Interpretation in Geology, Chapman & Hall Publications.
7. Keller,E.A., (1978), Environmental Geology,Merril.
8. Franklin W. Schwartz and Hunaozhang (2002). Fundamentals Ground Water John Wiley and New York.
9. Freeje and Cherry J.A. (1986) Ground Water Prentice Hall.
10. Gupta R.P. (2005),Remote Sensing in Geology, Springer Verlag Edition.
11. Haq,B.U.and Boerams A. (1978).Introduction to Marine Micropaleontology, Elsevier, New York,
12. Jones R.w. (1996).Micropaleonotology in Petroleum Exploration, Caarendon Press, Oxford
13. Karanth .K.R. (1987) Grounwater Assessment and Management, Tata McGraw Hill, New Delhi.
14. Kathal,P.K. (1998). Microfossils and their applications. CBS Publishers and Distributors, New Delhi.
15. Lillisand Kiefer R.W., (2000), Remote Sensing and Image Interpretation John Wiley SMS, New York.

16. Miall A.D (2000)Principles of Sedimentary Basin Analysis. Springer-Verlag.
17.Montgomery,C.W., (1986). Environmental Geology, Wn.C,Brown Publishers.
18. Pettijohn,F.J., (1975)Sedimentary rocks Harper an drow.
19. Thompson,D.B and Collinson,D. (1989)Sedimentary structures.unwin Hyman.
20. Todd.D.K. (2003).Groundwater Hydrology, John Wiley and Sons, New York.

**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 3** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: PEOs-Program Educational Objectives, POs -Program Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

**18MPAG03 GUIDE PAPER**

## PAPER III Optional Paper

## 1. MINERALOGY

**Course objective**

- To study the concept, silicate structure and importance of minerals.
- To Study the physical chemical and optical properties of rock forming minerals.
- To understand the crystallography, it's internal and external structures and the classification of crystals into systems and classes. and to know about the technique of x-ray diffraction pattern and their interpretation in mineralogy.
- To study the principles of optical mineralogy.
- To learn about Uniaxial and Biaxial minerals.

**Course outcome**

- To understand of basic techniques of mineral characterization
- To identify common rock forming minerals using diagnostic physical, chemical, and optical properties.
- Learning about crystallography and to infer the environment of formation of minerals.
- Understanding the concept in geochemical and petrological studies and the paragenesis of minerals
- This course also focuses on the analytical methods used in the chemical analysis of minerals.

**Unit I**

Mineralogy: Concepts and example of Isomorphism, Polymorphism, solid solutions. Structure and classification of silicates; detailed study of important silicates groups (Nesosilicates/Orthosilicates, Sorosilicates, Cyclosilicates, Inosilicates, Phyllosilicates and Tectosilicates) with reference to general and structural formulae, atomic structure, structural states/polymorphs, solid solution, stability of the minerals and modes of occurrence and alterations.

**Unit II**

Structure, relation of chemical composition with reference of optical, physical properties, alteration, and paragenesis of following group of minerals: Olivine, Pyroxene, Amphiboles, Garnet, Mica, Epidote etc.

**Unit III**

Crystallography: 32 classes of symmetry; concept of Space Group-Symmorphic and Asymomorphic space group; Concept of Miller Indices, Hermann-Mauguin notation; Types of crystal projection and their uses-Spherical and stereographic; X-ray Diffraction methods in mineralogical investigations-Bragg's Law, Ewald's sphere.

**Unit IV**

Principles of optical mineralogy: polarized light; optical mineralogy; behavior of isotropic and anisotropic minerals in polarized light: Birefringence, refractive index, double refraction, sign of elongation, Pleochroism, extinction angle, 2V, dispersion in minerals and pleochroic scheme.

**Unit V**

Uniaxial and Biaxial minerals. Concept of optical Indicatrix-Uniaxial Indicatrix and Biaxial Indicatrix. Use of Indicatrix, relation between crystallographic axes and the Indicatrix axes, Interference figures, Determination of 2V from Interference figures.

**Text /Reference Book**

1. Ford, W.E., Dana's Text book of mineralogy (Fourth Edition), Wiley Eastern Limited., New Delhi, 1989.
2. Putnis, A Introduction to mineral sciences, Cambridge University Press, New Delhi, 1992.
3. Deer, Howie and Zusmann, Introduction to Rock forming minerals, IBH Publishers, New Delhi, 1998.
4. Rogers and Kerr Optical Mineralogy, McGraw Hill Book Company, New Delhi, 1986.
5. Winchel and Winchel, Elements of Optical Mineralogy, John Wiley & Sons, INC. USA.,1989.
6. Dexter Perkins, Mineralogy, Prentice Hall, USA, 2002
7. Hans Rudolf Wenk and Andrei Bulakh, Minerals their constitution and origin, Cambridge University Press, UK, 2004.

**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 3 | 1 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 2 |
| **CO 2** | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 3 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 |

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## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 2. PETROLOGY

**Course objectives:**

- To understand the igneous petrology, structure of the earth, origin and characteristic of magma.
- To study the phase diagrams and igneous rocks of different tectonic Settings.
- For emphasis the Sedimentary Petrology.
- To understand the Texture and structure of metamorphic rocks.
- To understand the metamorphic facies and metasomatism.

**Course Outcome**

- Knowledge of the magma processes and igneous petrology.
- Analytical ability on different phase diagrams in igneous petrology.
- Knowledge and skill on Sedimentary Petrology.
- Knowledge and skill on Metamorphic Petrology.
- Knowledge on metamorphic facies and metasomatism.

**Unit I**

Igneous Petrology: Structure of the earth and origin of magmas. Characteristics of Magma. Intrusive and extrusive igneous rocks. Textures of igneous rocks. Magma differentiation. Crystallization of magma. Ascent and emplacement of magmas. General classification of igneous rocks

**Unit II**

Phase diagrams & igneous rocks of different tectonic Settings: Two component phase diagrams: Definitions – Phase Rule – Two component eutectic systems – Incongruent melting – Solid solution systems – Exsolution. Ternary phase diagrams: Crystallization in ternary systems. Igneous rocks of Ocean basins. Igneous rocks of convergent margins – Igneous rocks of Continental Lithosphere.

**Unit III**

Sedimentary Petrology: Description of Siliciclastic, argillaceous and carbonate sedimentary rocks: classification, texture, structure, origin, diagenesis and depositional environment of sandstones, conglomerate, breccias, shale, limestone and dolomite. Carbonaceous sedimentary rocks: evaporates, cherts, phosphorites and iron bearing sedimentary rocks. Geochemistry, Petrography and Field relations of Calc-Alkaline Volcanic Suits, Calc-Alkaline Plutonic suits, Sub alkaline Basaltic and ultramafic

suits, and Alkaline Suits. Distribution and tectono magmatic setting of important igneous complexes of India.

**Unit IV**

Metamorphic Petrology: Texture and structure of metamorphic rocks. Nomenclature and description of metamorphic rocks. Basic concepts of metamorphic reactions. Diagrammatic representations of mineral reactions and mineral paragenesis – ACF, AKF, AFM diagrams.

**Unit V**

Metamorphic Facies & Metasomatism: Facies classification and systematic description of regional and thermal metamorphism pelitic, basic-ultabasic and impure calcareous rocks. Metasomatism, ultra metasomatism and anatexis. Metamorphism and plate tectonics. Paired metamorphic belts – EPMA Studies – PT Estimates – ITD.

**Text /Reference Book**

1. Barker A.J. Introduction to Metamorphic Textures and Microstructures. 1st ed.,Blackie, Glasgow; 2nd ed., Stanley Thornes, Cheltenham, 1998.
2. Best M.G., Igneous and Metamorphic Petrology, 2nd ed. Blackwell. UK, 2002.
3. Hall, Anthony, Igneous Petrology. Longman, UK1996.
4. Mason R., Petrology of the Metamorphic Rocks, 2nd ed. Unwin Hyman, London, 1990.
5. Tony Philpotts Principles of Igneous and Metamorphic Petrology, Cambridge University Press, UK, 2006

**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 3 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 1 | 3 | 2 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 3. ECONOMIC GEOLOGY

**Course objectives**

- To get an idea on Principles of Economic Geology.
- To apply for internal processes of mineralization.
- To emphasis the surface processes of minerals.
- To understand the Global Tectonics and Metalogeny.
- To understand, the Indian Mineral Deposits and Mineral Economics.

**Course Outcome**

- To understand concepts of nature and morphology of the principal types of ore deposit.
- To know about Magmatic processes of mineralization.
- To identify the different surface process of minerals.
- To understand the global tectonics and metalogeny.
- To evaluate the mineral economics.

**Unit I**

Principles of Economic Geology: Introduction –The importance and history of mining - The nature and morphology of the principal types of ore deposit-Textures and structures of ore and gangue minerals-Fluid inclusion studies-Wall rock alteration-Geothermometry, Geobarometry, Paragenitic Sequence, Zoning and dating of ore deposits-Classification of mineral deposits.

**Unit II**

Internal Processes: Oregenesis- Ore deposits and ore minerals. Magmatic processes of mineralisation. Porphyry, skarn and hydrothermal mineralization. Mineralisation associated with (i) Ultramafic, mafic and acidic rocks, (ii) greenstone belts, (iii) Komatiites, Anorthosites and Kimberlites and (iv) Submarine volcanism. Magma-related mineralization through geological time. Stratiform and strata bound ores. Ores and metamorphism — cause and effect relations.

**Unit III**

Surface Processes: Introduction – Principles of chemical weathering – lateritic deposits- clay deposits – calcretehosted deposits – supergene enrichment of Cu and other metals in near surface deposits – clastic sedimentation and heavy mineral concentration – placer deposits – chemical sedimentation – banded iron formations – phosphorites and evaporates.

**Unit IV**

Global Tectonics And Metalogeny: Patterns in the distribution of mineral deposits – continental growth rates - crustal evaluation and metallogenesis – metallogeny through time – plate tectonics and ore deposits. Application of

fluid inclusion study and stable isotope geochemistry in understanding ore forming processes. Ore textures and paragenesis.

**Unit V**

Indian Mineral Deposits and Mineral Economics: Occurrence and distribution in India of metalliferous deposits - base metals, iron, manganese, aluminums, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals - mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries. Building stones. Phosphorite deposits. Placer deposits, rare earth minerals. Strategic, critical and essential minerals.

**Text/Reference Books**


1. Bateman, A. M. and Jensen, M. L. Economic mineral deposits, John Wiley and sons, New, York. 1981.
2. Gailbert, J.M., Park, C. P. Jr. and Freeman, W. H. The geology of ore deposits, John Wiley and sons, New York. 1986.
3. Krishnaswamy, S. India's mineral resources, Oxford and IBH publishing, New Delhi. 1979.
4. Edwards, R. and Atkinson, K. Ore deposit geology, Ist Edition, Chapman and Hall. New Delhi, 1986.
5. Robb, L. Introduction to ore-forming processes, Blackwell publishing, U.K., 2005.
6. Anthony Evans, Ore Geology and Industrial Mineral, Jhon Wiley & sons, USA, 1993
7. R.M. Umathay, Mineral Deposits of India, Dattsons, New Delhi, India, 2006


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 4. PALEOBIOLOGY AND STRATIGRAPHY

**Course Objectives**

- To understand the application of palaentologic studies in palaecology.
- To study the migration and dispersal of organisms applied to paleobiogeography.
- To make the students to understand the basic principles of stratigraphy.
- To understand the stratigraphic classification, Geologic time scale, nomenclatures.
- Major stratigraphic units, stratigraphic correlation, depositional environments, tectonostratigraphic framework of various stratigraphic units of India.

**Course Outcome**

- Acquire knowledge on the biostratigraphy, palaecology, palaeogeography and palaeoclimatology.
- Realize the importance of Paleozoic history and mega and micro fossils in the exploration of coal and petroleum.
- Learn the applications of sequence stratigraphy in petroleum exploration with case studies.
- Obtain the knowledge on Stratigratigraphy and its branches.
- Learn the Stratigraphy and brief sedimentation history of the Sedimentary Basins of India.

**Unit I**

Methods of fossil identification, description and illustration. Application of paleontological studies in organic evolution, biostratigraphy, palaecology, palaeogeography and palaeoclimatology. Microfossils: definition, significance and a brief account of important groups. Brachiopoda Morphology and geological distribution. Echinoidea: Morphology and geological distribution. Trilobite: Morphology and geological distribution.

**Unit II**

Concept of evolution and extinction; Micro and macro-evolution; Phylogenetic analysis; Distribution, migration and dispersal of organisms applied to paleobiogeography; Stable isotope studies of shells in paleoclimatology; Applications of important mega and micro fossils in the exploration of coal and petroleum. Dendrochronology and its application. Introduction to important microfossils.

**Unit III**

Introduction to Stratigraphy, Terms and concepts of Sequence Stratigraphy and its relationship with other branches of Stratigraphy. Sedimentary basin analysis through sequence Stratigraphy. Out crop and subsurface procedures. Global sea level changes/ eustatic sea level. Applications of sequence stratigraphy in petroleum exploration with case studies.

**Unit IV**

Stratigratigraphy and its branches. Stratigraphic correlation, stratigraphic classifications. Stratigraphic succession, Geological time scale, essential lithology and economic significance of the following Precambrian Cratons of India: Dharwar, Singhbhum, Bundelkhand, Aravalli.

**Unit V**

Stratigraphy and brief sedimentation history of the following Sedimentary Basins of India: Proterozoic: Delhi, Vindhyan Supergroups Phanerozoic Stratigraphy of India: Gondwana Supergroup. Triassic of Spiti, Jurassic of Kutch, Cretaceous of south east coast of India.

**Text / Reference Book**

1. Boggs, S. (2001) Principles of Sedimentology and Stratigraphy, Prentice Hall.
2. Danbar, C.O. and Rodgers, J. (1957) Principles of Stratigraphy, John Wiley and Sons.
3. Doyle, P. and Bennett. M.R. (1996) Unlocking the Stratigraphic Record, John Wiley and Sons.
4. Krishnan, M.S. (1982) Geology of India and Burma, C.B.S. Publ. and Distributors, Delhi.
5. Naqvi, S.M. and Rogers, J.J.W. (1987) Precambrian Geology of India, Oxford University Press
6. Allison, P.A. and Briggs, D.E.G. (1991) Taphonomy. Releasing the data locked in the fossils record, Plenum Press.
7. Bergland, B.E. (1986) Handbook of Holocene paleoecology & paleohydrology, John Wiley, New York.
8. Dodd, J. Robert and Stanton, Robert. J. Jr. (2012) Paleoecology: Concepts and Applications. Second Edition (Reprint), Wiley India Pvt. Ltd., New Delhi.
9. Dord, J.R. and Stanta, R.J. (1981) Palaeoecology concepts and applications, John Wiley and Sons.
10. Jones, T.P. and Rowe, T.P. (1999) Fossil Plants and Spores Modern Techniques, Geological Society of London.

## Outcome Mapping

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 3 |
| **CO 3** | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

**18MPAG03 GUIDE PAPER**

**PAPER III Optional Paper**

**5. MICROPALENOTOLOGY**

**Course objectives**

- To Learn the Introduction to Micropalaeontology its history and significance.
- To Interpret Surface and subsurface sampling method processing of samples.
- To Understand the Bryozoa and its uses.
- To understand the Ostracoda.
- To assess the Diatoms and their classification.

**Course Outcome**

- Describe the concept of Micropaleontology
- Categorize the various branches of Micropaleontology
- Identify the importance of Micropaleontology on environment.
- Analyze qualitative data systematically by selecting appropriate ecological analysis.
- Analyze the environmental and ecological significance of foraminifera and Ostracoda

**Unit I**

Introduction to Micropalaeontology: Palaeontology, its relation with other branches of science and scope; Micropalaeontology, its history and significance; Methods of sampling, treatment and separation of microfossils from rocks; Environments and biotic distribution. Foraminifera: Living animal, habit, life cycle; dimorphism; test shape, wall composition and structure; lamellar character of wall.

**Unit II**

Surface and subsurface sampling method Processing of samples: Morphology - classification - Evolution of foraminifera - Stratigraphy of foraminifera with special reference to India - Biometrics of larger Foraminifera - Paleo Environmental interpretation using microfossils - Ostracoda - Nanofossils- Radiolaria-Conodonts.

**Unit III**

Bryozoa - Role of micropaleontology in hydrocarbon exploration - Deep sea records with reference to Indian Ocean - Stable isotopic study in

foraminifera and interpretation of paleo temperature and paleo environment reconstruction.

**Unit IV**

Ostracoda: Living animal, life habit, morphology and classification. Classification ecology and stratigraphic distribution of Ostracoda. Use of Ostracoda in petroleum exploration. Conodonts: Elementary idea of Conodonts and their classification

**Unit V**

Diatoms: Elementary idea of Diatoms and their classification. Palynology: An elementary idea of Palynology and its applications

**Text / Reference Book**

1. Anantharaman, M.S. (2005) Paleontology: Evolution and Animal Distribution, 6th edition, Vishal Publishing Co, New Delhi.
2. Bignot, G. (1985) Elements of Micropalaeontology. Graham and Trotman.
3. Haq, B.V. and Boersma, A., (1998) Introduction to Marine Micropalaeontology, Elsevier.
4. Haynes, J.R. (1981) Foraminifera. John Wiley

**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 6. ADVANCES IN HYDROGEOLOGY

**Course objectives**

- To describe about the introduction of hydrogeology hydrological properties.
- To Illustrate the Hydrographic analyses and water balance.
- To Understand the Principle of groundwater flow
- To know about the Groundwater contamination.
- To learn about the Groundwater modeling.

**Course Outcome**

- Predict the origin and occurrence of ground water
- Describe the Occurrence of groundwater in various geological formations.
- Analyze the Groundwater flow systems and Hydrogeological boundaries.
- Assess the properties of Rocks for groundwater quality.
- Discuss the various types of groundwater modeling.

**Unit I**

Introduction: Scope - Hydrologic cycle – hydrograph - origin and source - distribution of groundwater – aquifers – aquifer compressibility -porosity - rock properties – specific yield, storage coefficient – groundwater occurrence in various geological formations – geological structures – Aquifer mapping – Microlevel aquifer mapping - Hydrogeology of India.

**Unit II**

Hydrographic analyses: hydrograph separation, base flow recession, storm hydrograph. Gaining and losing streams. Water balance: groundwater recharge, discharge and balance, estimation of recharge components, estimation of groundwater discharge, water balance-case histories. Occurrence of groundwater in various geological formations. Spring (including thermal): type, origin and movement of water.

**Unit III**

Principle of groundwater flow: mechanical energy, hydraulic head, force potential and hydraulic head, Darcy Law in terms of force potential. Step draw down test (SDT) and its application in evaluation of well performance. Aquifer performance test (APT), determination of aquifer parameters using Theis recovery, Boultons and distance draw down methods. Hydrogeological boundaries; recharge boundary condition and barrier boundary. Determination of aquifer boundaries.

**Unit IV**

Groundwater contamination: septic tank and cesspools, landfills, chemical spills and leaking underground tanks, mining and other sources of groundwater contamination. Bacteriological analyses of drinking water: faecal coliform bacteria. Trace elements: source, trace element and health hazards. Isotope hydrology: tritium, radiocarbon dating of groundwater, stable isotope of oxygen and hydrogen and other isotope. Fossil water and its significance.

**Unit V**

Groundwater modeling: Physical scale model, analog models; their principal characteristic application and limitations. R-C analog model. Mathematical models: analytical and numerical approaches. Numerical model: finite difference and finite element models. Conceptualization including defining the aquifer system and its boundaries. Discritization and data requirement. Groundwater contamination modeling: Principles and concepts. Classification of groundwater contamination models.

**Text / Reference Book**


1. Chow, V.T., 1988: Advances in Hydroscience-McGraw Hill
2. Walton, W.C., 1988: Ground Water Resource Evolution-McGraw Hill
3. Black, W. and Others (Ed.), 1989: Hydrogeology-Geol. Soc. Of America Publ.
4. Mahajan, G., 1990: Evolution and Development of Ground Water-D.K. Publisher
5. Tolman, C. F. 1937 Groundwater, McGraw Hill, New York and London.
6. Todd, D. K. 1995 Groundwater Hydrology, John Wiley and Sons.
7. Driscoll, F. G. 1988 Groundwater and Wells, UOP, Johnson Div. St. Paul. Min., USA.
8. Raghunath, H. M. 1990 Groundwater, Wiley Eastern Ltd.,
9. Nagabhushaniah, H. S. 2001 Groundwater in Hydrosphere (Groundwater hydrology), CBS, Publ.
10. Karanth, K. R. 1989 Hydrogeology, Tata McGraw Hill Publ.


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 7. ADVANCES IN SEDIMENTARY ENVIRONMENTAL MODELING

**Course objectives:**

- To understand the environmental systems.
- To assess the Sedimentary cycles, rythms and cyclothems.
- To learn about the sedimentary basins of India.
- To build knowledge about the sequence of stratigraphy and historical perspective.
- To demonstrate about the Trace fossils.

**Course Outcome**

- An overview of mathematical models applied to various environmental issues, need, scope and objectives of environmental modeling.
- Analysis of sedimentary facies and preparation of facies maps.
- Explain the dynamics and primary structures associated with the environments.
- Describe the sequence stratigraphic tools and application to depositional system.
- Explain the trace fossils and their occurrence, association and petrographic characteristics.

**Unit I**

Environmental systems – an introduction: An overview of mathematical models applied to various environmental issues, need, scope and objectives of environmental modeling. Role of mathematical models in environmental quality management. Model classification – Brief review of different states involved in model building. Calibration and verification of model, limitations in modeling.

**Unit II**

Sedimentary cycles, rythms and cyclothems. Analysis of sedimentary facies and preparation of facies maps. Lithofacies, biofacies, dynamics and primary structures associated with the environments- alluvial fan, river plains, glaciers, deltas and estuaries.

**Unit III**

Sedimentation pattern and depositional environment of selected undeformed sedimentary basins of India representing Precambrian, Phanerozoic and contemporary basins. Volacniclastics- formation and general characteristics, types of pyroclastics.

**Unit IV**

Sequence stratigraphy-historical perspective, concepts and principles, sequence stratigraphic tools, application to depositional system. Clay deposits-physical properties, mineralogy, chemistry and genesis.

Evaporitesmineralogy, physico-chemical controls on precipitation and dissolution. Phosphorites- mineralogy, occurrence. origin of various types of cement.

**Unit V**

Trace fossils- occurrence, association and petrographic characteristics, use of trace fossils, stromatolites, thrombolites and related structures in paleoenvironment analysis.

**Text / Reference Book**


1. Allen, J.R.L., 1985: Principles of Physical Sedimentation-George Allen & Unwin
2. Allen, P., 1997: Earth Surface Processes-Blackwell
3. Nichols, G., 1999: Sedimentology and Stratigraphy-Blackwell
4. Reading, H.G., 1996: Sedimentary Environment-Blackwell
5. Davis, R.A. Jr., 1992: Depositional System-Prentice Hall
6. Einsele, G., 1992: Sedimentary Basins-Springer Verlag
7. Reineck, H.E. and Singh, I.B., 1980: Depositional Sedimentary Environments-Springer Verlag
8. Miall , A.D., 2000: Principles of Sedimentary Basin Analysis-Springer Verlag
9. Pettijohn, F.J., Potter, P.E. and Siever, R., 1990: Sand and Sandstone-Springer Verlag.
10. Bhattacharya, A. and Chakraborti, C., 2000: Analysis of Sedimentary Successions-Oxford-IBH
11. Boggs Sam Jr., 1995: Principles of Sedimentary and Stratigraphy-Prentice Hall


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 8. REMOTE SENSING IN APPLIED GEOMORPHOLOGY

**Course objectives**

- To Illustrate about the principles and components of GIS.
- To know in detail how Electromagnetic Spectrum is related to the field of remote sensing.
- To understand the basic concepts and significance of geomorphology.
- To know in detail about the streams and their geological agents.
- To Introduce about the Morphometric analysis.

**Course Outcome**

- Describe the basic principles of Remote Sensing
- Describe the Electromagnetic spectrum.
- Formulate the relationship of wind, desert and glaciers geomorphology.
- Categorize insight into different kinds of Fluvial landforms
- Predict the basin morphometric analysis.

**Unit I**

Principles and components of GIS, remote sensing data integration with GIS, applications of GIS in various geological studies. Concept of Geo-Spatial referencing, Projection Systems, Working principle of GPS.

**Unit II**

Electromagnetic radiation – characteristics, remote sensing regions and bands; General orbital and sensor characteristics of remote sensing satellites; Spectra of common natural objects – soil, rock, water and vegetation. Aerial photos – types, scale, resolution, properties of aerial photos, stereoscopic parallax, relief displacement; Digital image processing - characteristics of remote sensing data, preprocessing, enhancements, classification; Elements of photo and imagery pattern and interpretation, application in Geology; Remote sensing applications in interpreting structure and tectonics; Lithological mapping, mineral resources, groundwater potentials and environmental monitoring.

**Unit III**

Basic concepts and significance of geomorphology; Weathering and Erosion; Cycle of erosion. Wind as a geological agent; Wind erosion, transportation and deposition; Aeolian landforms: formation, types and evolution. Deserts: types and associated landforms. Glaciers: types, formation and morphology;

Glacial erosion, transportation and deposition; Glacial landforms: formation, classification and evolution Karst Topography: formation, classification and evolution.

**Unit-IV**

Streams as geological agents; Rivers: evolution of a river system and drainage patterns; Strahler's method of stream ordering; Stream erosion, transportation and deposition; Fluvial landforms: types, formation and evolution. Coastal Geomorphology; Marine landforms: formation, classification and evolution.

**Unit V**

Morphometric analysis; Neotectonics - geomorphological indicators, active faults, responses of drainages with respect to tectonic activity. Morphochronology: OSL, IRSL, Radio nuclide Dating.

**Text / Reference Book**


1. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Private Limited, 2005 ISBN 8173715351, 9788173715358
2. Lillesand. TM.,Kiefer, R.W and Chipman, K.W. Remote sensing and image imterpretation Fifth Edition. Wiley. 2007.
3. Ravi P. Gupta, Remote Sensing Geology, Springer-Verlag New York, 2002.
4. Burrough, PA; and RA McDonnell. Principles of Geographic Information Systems. Oxford Press, U.K., 1998.
5. Wolf. P. R. Elements of Photogrammetry. Mc Graw Hill, Japan, 1993.
6. G. Rees. Physical Principles of Remote Sensing. Cambridge University Press, U.K., 2000.
7. SN Pandey, Principles and Applications of Photogeology: New Age International (P) Ltd., New Delhi. 1988.


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 1 | 3 |
| **CO 3** | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 9. GEOINFORMATICS IN RESOURCE MAPPING

**Course objectives**

- To understand the definitions, concepts and types of remote sensing.
- To acquire knowledge about the application land use in remote sensing.
- For emphasis the Coastal Zone Management.
- To understand the applications of GIS in disaster management.
- To understand the remote sensing application in Groundwater Resources.

**Course Outcome**

- Describe the basics of remote sensing technologies.
- To explain the land use resource mapping.
- Assess the coastal regulation zone resource mapping.
- Discuss the different disaster management plans.
- Knowledge on the groundwater resource mapping.

**Unit I**

Definitions, concepts and types of remote sensing, evolution, stages and advantages of remote sensing, spatial data acquisition, Electromagnetic spectrum, Characteristics of electromagnetic radiation, wavelength regions of electromagnetic radiation, types and platforms of sensors Digital Image Processing: Remote Sensing Technologies: Thermal Remote Sensing

**Unit II**

Land Use: Land use systems, land utilization types; land use classifications – rural and urban land uses and land use patterns, Municipal Lands and Open Spaces in Cities and Town, Agriculture and Forest Land Management, Recreational Lands, Wetland Management. Urban Planning and Mapping: Importance and types of plans, urban and regional planning, LU/LC mapping, GIS data modeling for urban design, urban infrastructure, urban site selection for urban development, site suitability analysis for utilities and civic amenities; Urban mapping: physical structure and composition of urban areas, urbanization process, growth trend, problems of urbanization, urban sprawl and associated problems.

**Unit III**

Coastal Zone Management: Introduction, major issues/ problems, Thematic maps on coastal resources, wetland classification, mapping of shore line

changes, coastal interactions, coastal regulation zone mapping, creation of CZIS, ICZM model concepts and case studies, resolving conflict on resources utilization, coastal aquifer modeling.

**Unit IV**

Applications of GIS in Disaster Management: Drought and Forest Fire: drought monitoring, GIS based drought analysis, desertification factors, monitoring vegetative biomass; Forest Fire – causes, management using GIS, risk zonation mapping, forecasting system. Earthquake, volcanoes, landslides and soil erosion: Causes, types, effects and mitigation measures, RS and GIS in earthquake prediction and post-quake rehabilitation, GIS for earthquake disaster management, mapping tectonic lineament; Volcano: RS of geothermal field, mapping lava flows, volcano hazard management; Landslides: RS and GIS for zonation, monitoring and management; Soil erosion: RS and GIS for soil erosion and sediment estimation, Flood, Cyclone: cyclone monitoring using INSAT, ERS-1, NOAA and DMSP satellites, Tsunami: types, causes, RS and GIS for warning, damage assessment and rehabilitation.

**Unit V**

Ground Water Resources: Groundwater potential assessment, groundwater prospect zones mapping, modeling, planning and management, forecasting, selecting the appropriate site for artificial recharge by using RS and GIS, quality mapping, ground and surface water interactions, fluorosis, nitrate pollution and heavy metal contamination.

**Text / Reference Book**

1. Lillesand, Thomas M. and Kiefer, Ralph, W., “Remote Sensing and Image Interpretation”, 4th Edition, John Wiley and Sons, New York, 2000
2. Gupta RP, Remote Sensing Geology, Springer-Verlag Berlin Heidelberg 2003
3. Curran PJ, Principles of Remote Sensing, ELBS, 1988
4. George Joseph, “Fundamentals of remote sensing”, Universities press, 2003
5. Sabins, F.F. Jr., ‘Remote Sensing – Principles and Interpretation”, W.H. Freeman & Co., 2002 Edition.
6. Jensen, JR. (2006), Remote Sensing of the Environment- An Earth Resources Perspective, Prentice Hall Inc.
7. Campbell, James B., (2006), Introductory Remote Sensing: Principles and Concepts, Routledge
8. Gibson, P.J., (2000), Introduction to Remote Sensing, 2nd ed., Taylor & amp; Francis, London.

9. Cracknell, A.P. & Hayes, L.W B., (2007), Introduction to Remote Sensing, Taylor & Francis, London.

**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 3 |
| **CO 3** | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |
| **CO 4** | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 10. ENVIRONMENTAL GEOLOGY

**Course objectives:**

- To understand the concept and scope of environmental geology.
- To assess the Terrestrial Environment processes.
- To attain the Aquatic Environment management.
- To Geology in environmental planning and management.
- To acquire knowledge about the various types Geological Hazards.

**Course Outcome**

- Assess the basics of Environmental Geology.
- Explain the concept of Environmental degradation due to mining and ore beneficiation.
- Analyze the risk and mitigation of groundwater and marine water.
- Explain the environmental impact assessment.
- Describe the geological Hazards and Global Environmental Change.

**Unit I**

Geologic Environments: Concept and scope of environmental geology – understanding earth processes and landforms; Geological characteristics of various environmental regimes – fluvial, coastal, marine, Aeolian, desert, and glacial. - Landforms as ecosystem units – Geomorphic controls on biodiversity and its conservation.

**Unit II**

Terrestrial Environment: Environmental degradation due to mining and ore beneficiation – impact and management – Indian case studies - soil and mineral resources and their conservation

**Unit III**

Aquatic Environment: Geological factors influencing the formation of surface, groundwater and marine Waters – geological basis of groundwater, surface and marine water pollution and management with Indian case studies

**Unit IV**

Geology in environmental planning and management: Environmental impact assessment – geological appraisal of waste disposal sites - geology in planning and siting of landfills - problems of deep well disposal, radioactive waste management - land use planning in EIA.

**Unit V**

Geological Hazards and Global Environmental Change: Causes, types, Mitigation and Management of earthquakes, landslides, tsunami and volcanoes. Causes and Indicators of global environmental change

**Text / Reference Book**


1. Montgomery, C.W. Environmental Geology, Won. C. Brown, Publishers, Iowa, 1989.
2. Dorothy Merritts, Andrew de Wet, Kirsten Menking, Environmental Geology W. H. Freeman & Co. and Sumanas, Inc. USA, 1997
3. Valdiya, K. S, Geology, Environment and Society, Universities Press, India, 2004
4. Jonathan Turk and Graham R. Thompson, Environmental Geoscience: Saunders College Division, 2000.
5. Savindra Singh., Environmental Geography, Prayag Pustak Bhawan, Allahabad, 2012
6. Edward A. Keller, Environmental Geology (8th Edition) Prentice Hall, 1999.
7. Misra., S. P & Pandey, S.N., Essential Environmental studies, 3rd Edition, Ane Books, Pvt. Ltd, 2011.


**Outcome Mapping**

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

## 18MPAG03 GUIDE PAPER

## PAPER III Optional Paper

## 11. APPLICATION OF GEOCHEMISTRY IN ENVIRONMENT SYSTEM

**Course Objectives:**

- To understand the Principles of Environmental Geochemistry.
- To assess the Geochemistry and water quality.
- For emphasis the Geochemistry and man, health and disease.
- To understand the Heavy metal contamination from base metal mining and smelting.
- To understand the Concept of Primary and Secondary Environments.

**Course Outcome**

- Knowledge of the metal pollution in soils, sources and types of metal pollution.
- Field and laboratory knowledge in water quality analyses.
- Knowledge and skill on difference water based diseases.
- Knowledge and skill on some the environmental pollution.
- Knowledge on Geochemistry in Exploration and Mapping.

**Unit I**

Principles of Environmental Geochemistry: types of chemical reactions, oxidation-reduction processes in natural systems, the distribution of elements in rocks and some geochemical associations, re-distributions of chemical elements by weathering. Sources of trace elements in soils, trace element problems in crops and livestock. Assessment of metal pollution in soils, sources and types of metal pollution.

**Unit II**

Geochemistry and water quality, measures of water quality, chemical analysis, physical and , Biological analysis, COD, BOD, Water quality criteria, factors influencing ground water quality, Bioremediation, Types of bioremediation, approaches to bioremediation, bioremediation of contaminated soils & aquifers, bio-indicators.

**Unit III**

Geochemistry and man, health and disease, essential elements, toxic and other elements, special problems of health and environment, health effects of silica, asbestos exposure, biological interactions trace elements and diseases, natural trace element poisoning, health implications of coal development.

**Unit IV**

Heavy metal contamination from base metal mining and smelting, implication for man and environment, metal mining and human health. Radioactivity in the environment, radioactive elements in rocks, radio-elements in soils and water, environmental aspects of radionuclides. Environmental pollution on global nature, acid rain, greenhouse effect, ozone layer, CFCs, atmospheric pollution, sampling and analysis. Industrial pollution

**Unit V**

Concept of Primary and Secondary Environments; Drainage patterns, Mobility of Trace Elements in Secondary Environment; Adsorption Phenomena – Hydrous Fe and Mn Oxides; Chemical Phases present in Drainage Sediment; Primary Secondary and Tertiary ( First, second, third and fourth order streams) Streams; Drainage Geochemistry in Exploration and Mapping; Modern Methods in Drainage Geochemistry; Advantages of Regional Geochemistry; Ultraviolet minerals in Exploration; Geomorphology and development of drainage systems – Influence of Topography on dispersion.

**Text / Reference Book**

1. Iain Thornton, (1983): Applied Environmental Geochemistry, Academic press
2. J.S.Webb,(1980): Environmental Geochemistry and Health, The Royal Society, London
3. Faure Gunter, (1992): Principles and Applications of Inorganic Geochemistry, Macmillan Pub
4. Konrad B. Krauskopf, (1995): Introduction to Geochemistry III Ed. McGraw Hill Co.
5. Arthur H. Brownlow (1996): Geochemistry, Prentice Hall Inc
6. Brian Masson (1983) Principles of Geochemistry, 4th edition McGraw Hill Co.
7. John K. Joseph (2006) Organic Geochemistry, Campus Books International
8. A.W.Rose, H.E.Hawkes and J.S.Webb, (1979): Geochemistry in Mineral Exploration. 2nd edition. Academic Press, New York
9. H.L.Barnes, (1979): Geochemistry of Hydro-thermal Ore Deposits. 2nd Edition. John Wiley

## Outcome Mapping

| POs& PSOs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| **CO 2** | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 |

Note: POs-Program Outcomes, PSOs -Program Specific Outcomes and CO-Course Objective and Cognitive level: K1- Remembering, K2-Understanding & K3- Applying.

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