To
The Additional Secretary,
Governor's Secretariat,
Raj Bhawan,
Patna - 800 001.

14.06.2014.

Subject: Revision/Correction of the C.B.C.S. syllabus in Geology

Sir,

Please find attached herewith a copy of the C.B.C.S. syllabus in Geology revised/corrected by a committee at its meeting held at Raj Bhawan on 14.06.2018.

Thanking you,

Yours faithfully

1. Prof. R.K. Mishra - R.K. Mishra 14.06.18
2. Prof. Ramesh Shukla
3. Prof. Atul Aditya Pandey 14/6
4. Ms. Sayema Jamal 14/6/18

Encl: Copy of the Revised/Corrected syllabus.

Course Structure for M.Sc. Geology (Choice Based Credit System)
for Session 2018-20

Semester	Course/ Paper Code	Nature of Course/ Paper	Credit	Marks	Marks of CIA	Marks of ESE	Passing criterion	Qualifying Criterion
SEMESTER I	MGELCC-1	Structural Geology and Geotectonics	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-2	Mineralogy, Crystallography & Optical Mineralogy	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-3	Igneous Petrology & Geochemistry	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-4	Practical	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELAECC-1	Environmental Sustainability & Swachch Bharat Abhiyan	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER II	MGELCC-5 DSE-1 for other Department	Geomorphology, Remote Sensing & GIS	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-6	Sedimentology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-7	Metamorphic Petrology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-8	Stratigraphy & Palaeontology (I)	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-9	Practical	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELAEC-1 /SEC-1	One Ability Enhancing Elective course (selected from basket)	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER III	MGELCC-10	Environmental Geology & Hydrogeology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-11	Engineering Geology & Geo-Exploration	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-12	Economic Geology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-13	Stratigraphy & Palaeontology (II)	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-14	Practical	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELAECC-2	Human Values & Professional Ethics and Gender sensitization	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER IV	MGELEC-1	Subject specific elective	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELEC-2	Subject specific elective	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELDSE-1	Discipline Specific Elective (Opt a Course from other Department)	5	100	30	70	45% in CIA 45% in ESE	Qualifying

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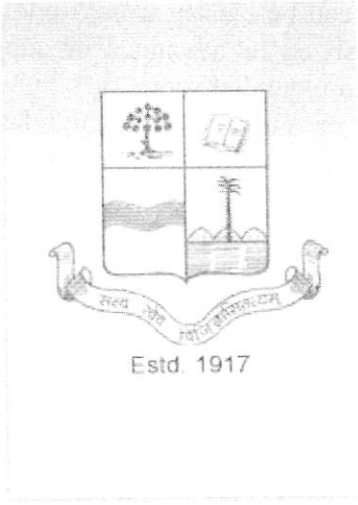
SYLLABUS FOR M.Sc. IN GEOLOGY
UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)
(To be effective from 2018-20)



UNIVERSITIES OF BIHAR
&
PATNA UNIVERSITY

14/06/18

14.06.18

14/6/18

OUTLINE OF THE CHOICE BASED CREDIT SYSTEM (CBCS) for PG degree courses:

It consists of a number of courses i.e. **Core Course (CC), Elective Course (EC),Discipline Specific Elective Course(DSE), Ability Enhancement Courses(AEC) and Ability Enhancement Compulsory Courses(AECC).** Each course is equivalent to a paper .The nature of these courses are defined below:

1.1 Core Course(CC):
A course which should compulsorily be studied by a candidate as a core requirement on the basis of MSC studies and is termed as a Core course.

1.2 Elective Course(EC):
Generally a course which can be chosen from a pool of courses(Basket) and which may be very specific or specialized or advanced or supportive to the subject/discipline of study or which provides an extended scope or which enables an exposure to some other subject/discipline/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

1.3 Discipline Specific Elective Course(DSE):
Elective courses may be offered by the main discipline/subject of study is referred to as **Discipline Specific Elective.** The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

1.4 Generic Elective(GE) Course :
An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a **Generic Elective.**
P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

1.5 Ability Enhancement Courses (AEC):
The Ability Enhancement Courses (AEC)/Skill Enhancement Courses (SEC)."AEC"courses are the courses based upon the content that leads to life skill enhancement.

1.6 Ability Enhancement Compulsory Courses(AECC):
(Qualifying and Non-CGPA course):
University will run a number of **Ability Enhancement Compulsory Courses (AECC)** which is qualifying in nature and student from all faculties have to qualify in all courses.

1.7 Dissertation/Project/Internship/Industrial Training

An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work and a candidate studies such a course on his own with an advisory support by a teacher / faculty member is called dissertation/project.

2.0 CREDIT

The total minimum credits, required for completing a PG program is 100.
The details of each credit for individual components and individual courses are given in Table.2

Table 1 : Structure of the 2Yrs(Four Semester) Post Graduate Degree course under CBCS :

Semester	No. Of COURSE /Papers	Credit per COURSE/ paper	Total Credit	Minimum No. Of Learning Hours #	No. Of CORE COURSE/ PAPER	No .of ELECTIVE Course /PAPER	Code & Nature of Elective Course/paper
I	05	05	25	250	4	1	AECC-1
SEMESTER BREAK							
II	06	05	30	300	5	1	AEC-1
SEMESTER BREAK							
III	06	05	30	300	5	1	AECC-2
SEMESTER BREAK							
IV	03	05	15	150	1	3	EC-1* EC-2* DSE-1 Or GE-1
TOTAL	20		100	1000	14	6	

#For Tutorial (T)/Practical (P)/Field Work (FW)/Internship etc. extra working hour to be added as per requirement and will be decided by the BOCS of the respective subject.

***The two Elective Courses (EC) to be studied in semester IV may be**
Both theory papers
/One Theory paper and One Practical Paper
/One Theory paper and One Project Paper
/One Theory paper and One Field Work
/Both Project work /Internship

IMP: It is desirable that all students of all courses be given adequate exposure over and above the class room teaching to enhance the scope of employability.

2.1 The distribution of the six elective papers shall be – two EC, one DSE or one GE, two AECC, one AEC. Student may opt for any elective course out of a list of elective papers (**Basket**) offered by the parent department or any other departments/s as per his/her choice with the prior permission of the parent department. The list of elective papers, syllabus and prerequisite of the elective course will be as decided by the Board of Courses of Studies (BOCS) of the concerned subject/department.

2.2 The final CGPA/class will be decided on the performance of the student in the 16 courses/papers including the 14 Core Courses (CC)/papers and two EC/papers.

2.3 The one DS or one GE, two AECC, one AEC papers will be qualifying in nature and a student has to score at least 45% marks in these papers. Grades will be awarded separately for these courses, however, performance in these elective courses/papers will not be considered for awarding the final CGPA/class.

2.4 Ability Enhancement Compulsory Courses (AECC);

University will run two **Ability Enhancement Compulsory Courses** (AECC) which are qualifying in nature and a student has to qualify in both these courses. The courses are:

AECC-1 : Environment Sustainability(3 Credit)
& Swachchha Bharat Abhyian Activities(2 Credit)

AECC-2 : Human Values & Professional Ethics(3 Credits)
& Gender Sensitization(2Credit)

Students will do assignments/project work related to institutional social responsibilities including Swachchha Bharat Abhyian Activities during SEMESTER BREAK.

2.5 University will run a number of **Ability Enhancement Courses** (AEC) and Skill Enhancement Courses; a student can choose one from these. For example:

Basket Ability Enhancement Courses(AEC)

- Computers and IT Skill
- Web Designing
- Financial Risk Management/
- Solid Waste Management/
- Mushroom Culture/
- Bio-fertilizer production/
- Environmental Law/
- Tourism & Hospitality Management/
- Lifeskill & skill development/

- Yoga Studies

etc.

2.6 Discipline Specific Elective (DSE) :

In each subject the CC/paper-5 being taught in the second semester will be open to be selected as a DSE paper. In the first phase a student will be allowed to choose a paper from any subject other than his/her Core Course (CC) from the same faculty in the same university.

2.7 Generic **Elective (GE) Course**:

University will run a number of Generic Elective Courses (GE); a student can choose one from these. For example:

Basket of GE courses

- Music
- Dramatics
- Fine ARTS
- Graphic Design
- Inclusive Policies
- Human Rights
- Any course run by any department

PATNA UNIVERSITY

DEPARTMENT OF GEOLOGY

M.Sc. (GEOLOGY) SEMESTER SYSTEM W.E.F 2018-20

Candidates who have passed the three year B.Sc. (Hons.) examination of Patna University or any other equivalent examination of other universities with Honours in Geology will be considered eligible for admission to the Four Semester M.Sc. course in Geology.

The M.Sc. course in Geology shall be imparted to the students for two academic sessions consisting of four semesters (a total of 2000 marks) as given below. Candidates will be examined and evaluated at the end of each semester in the different courses of theory and practical as per continuous internal assessment (CIA) and semester examinations (conducted by the University). The M.Sc. Geology will consist of a number of courses i.e. Core Courses(CC), Elective Courses(EC),Discipline Specific Elective Course(DSE) , Ability Enhancement Courses(AEC) and Ability Enhancement Compulsory Courses(AECC). Each course is equivalent to a paper.

(a) The Core courses will be compulsory for all the students admitted to M.Sc. Geology. There will be core courses of 100 marks each ((theory - 11 papers, and practical- 3 papers) and two sessions of geological field training. After the field training, the students will be required to submit a detailed field report to the concerned teacher for evaluation. The attendance in the geological field training will be compulsory for all the students.

(b) The students admitted will have to study two **Elective** papers of 100 marks each during IVth Semester.

MARKS DISTRIBUTION IN SEMESTER EXAMS & CIA :

Exam. Components	Marks for Semester Exam.	Intra-Sessional Semester Test + Seminar /Quiz + Assignment + Regularity and Conduct(CIA)	Intra-Sessional Semester Practical + Seminar /Quiz + Assignment + Regularity and Conduct(CIA)	Total Marks
Theory	70	30 (15 +5+5+5)	-	100
Practical	70	-	30 (15+5+5+5)	100

M.Sc Geology

PROGRAM OBJECTIVE:

1. *To produce a capable workforce that is trained to endeavor for a sustainable development of the earth resources and mankind in general.*
2. *To develop a strong student competency in the field of Earth Science and its application for the development of the nation.*
3. *To impart students with adequate details about the application of data based on geological investigations for different organizations and industry related to earth science.*
4. *To generate a steady supply of human resource equipped with latest knowledge related to engineering geology, geo-exploration, hydrogeology, fuel geology, remote sensing & GIS etc.*

COURSE STRUCTURE

SEMESTER - I

Code	COURSES	Credit	Marks of CIA	Marks of ESE	Total
MGELCC-1	STRUCTURAL GEOLOGY & GEOTECTONICS	5	30	70	100
MGELCC-2	MINERALOGY, CRYSTALLOGRAPHY, & OPTICAL MINERALOGY	5	30	70	100
MGELCC-3	IGNEOUS PETROLOGY & GEOCHEMISTRY	5	30	70	100
MGELCC-4	PRACTICAL	5	30	70	100
MGELAECC-1	ABILITY ENHANCING COMPULSORY ELECTIVE	5	50	50	100
	Total	**25**	**170**	**330**	**500**

SEMESTER – II

Code	COURSES	Credit	Marks of	Marks of	Total
MGELCC-5	GEOMORPHOLOGY , REMOTE SENSING & GIS	5	30	70	100
MGELCC-6	SEDIMENTOLOGY	5	30	70	100
MGELCC-7	METAMORPHIC PETROLOGY	5	30	70	100
MGELCC-8	STRATIGRAPHY & PALEONTOLOGY(I)	5	30	70	100
MGELCC-9	FIELD TRAINING AND LAB WORK	5	30	70	100
MGELAEC-1	ABILITY ENHANCING ELECTIVE PAPER	5	50	50	100
	Total	**30**	**200**	**400**	**600**

SEMESTER - III

Code	COURSES	Credit	Marks of	Marks of ESE	Total
MGELCC-10	ENVIRONMENTAL GEOLOGY & HYDROGEOLOGY	5	30	70	100
MGELCC-11	ENGINEERING GEOLOGY & GEO-EXPLORATION	5	30	70	100
MGELCC-12	ECONOMIC GEOLOGY	5	30	70	100
MGELCC-13	STRATIGRAPHY &	5	30	70	100
MGELCC-14	PRACTICALS	5	30	70	100
MGELAECC-2	DISCIPLINE SPECIFIC ELECTIVE	5	50	50	100
	Total	**30**	**200**	**400**	**600**

SEMESTER - IV

Code	COURSES	Credit	Marks of	Marks of	Total
MGELEC-1	**ELECTIVE PAPER** -ADVANCED HYDROGEOLOGY - FUEL GEOLOGY -ADVANCED SEDIMENTOLOGY -GEOCHEMISTRY	5	30	70	100
MGELEC-2	FIELD TRAINING (ELECTIVE) AND LAB WORK	5	30	70	100
MGELDSE-1 OR MGELGE-1	**DSE-1 (Discipline Specific Elective)** **GE-1 (Generic Elective)** May be unrelated to subject/across	5	30	70	100
	Total	**15**	**90**	**210**	**300**

Note: Passing criterion in each semester exam is 45%.

PROGRAM OUTCOME:

1. *The generation of trained personnel ready to serve in the realms of teaching and research in Earth Science.*
2. *The production of a strong contingent of Earth scientists adequately trained in both theoretical and practical aspects of geology.*
3. *The program shall equip students with the technological tools and skills competent enough to analyze geological data and information for the best utilization in Earth Science studies.*
4. *A significant outcome of the program shall be the production of versatile geologists who understand the significance of sustainable utilization & development of Earth resources*

SEMESTER-I
PAPER CODE: MGELCC-1
STRUCTURAL GEOLOGY & GEOTECTONICS

Course Objective:

1. To introduce the idea of Structures and structural analysis
2. To give the concept of stress, and strain
3. To explain mechanism of folds and faults
4. To give the idea of structural fabrics and weak zones
5. To give the concept of Geotectonic of Earth

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Structural Geology:

Unit-I

- Introduction to Structural Analysis (types).
- Concept of stress and strain. Types of strain ellipses & ellipsoids – their properties & geological significance.
- Behaviour of rocks under stress: elastic, plastic, viscous and visco-elastic responses and their geological significance.

Unit-II

- Mechanical principles and properties of rocks and their controlling factors. (Confining pressure, temperature, time, pore fluid pressure etc).
- Strain Analysis: Methods of strain measurements in naturally deformed rocks and Graphical representations of strain (Flinn, Ramsay and Nadai-Hossack plots).
- Mohr diagrams and their use; Coulomb's criterion and Griffith's theory.

Unit-III

- Description of Joints and their geological significance.
- Shear zones: geometry, kinematics and their significance.
- Planar & linear fabrics in deformed rocks, their origin & significance. Basic idea about petro-fabrics.

Unit-IV

- Description of Folds. Mechanics of folding and buckling, Flexure folds; flexure flow folds. .
- Description of Faults. Mechanics of faulting: Anderson's theory and its limitations.
- Effects of faulting on the outcrops & folded strata.

Geo-tectonics:

Unit-V

- Concept of Orogeny .
- Concept of Continental Drift, Sea-floor spreading and theory of Plate tectonics
- Structure and origin of the Alpine – Himalayan Belt and Evolution of the Indo – Gangetic Basin

Course Outcome

1. Knowledge of behavior of rocks and their geological significance
2. Ability to analyse strain ellipses and ellipsoid
3. Understand the concept of Mechanics of folding and faulting
4. Know the significance of planar and linear fabrics
5. Understand the evolution of the continenets and Ocean basins

SEMESTER-I

PAPER CODE: MGELCC-2

MINERALOGY, CRYSTALLOGRAPHY, & OPTICAL MINERALOGY

Course Objective:

1. To introduce the basic idea of mineralogy
2. To explain crystal structure
3. To study in detail the mineral groups
4. To give the idea of Crystal System
5. To give the concept of Optical properties of minerals

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Mineralogy

Unit-I

- Introduction to mineralogy: classification of minerals.
- Structural and chemical principles of minerals, chemical bonds, ionic radii, coordination number
- Mineral systematics -Crystal structure, diagnostic properties, P-T stability – Phase diagram.

Unit-II

- Detailed study of Olivine, Pyroxene and Amphibole, Mica, Feldspar, Silica, groups.

Unit-III

- Crystal structure, diagnostic properties, paragenesis, and alteration – Kyanite, Sillimanite, Andalusite, Felspatholids, Epidote, Garnet
- Brief study of the following minerals-
  Talc, gypsum, calcite, fluorite, apatite, topaz, corundum, magnetite, pyrite, spinel, , galena, tourmaline, beryl, barite, chlorite, sphene, vesuvianite.

Unit-IV Crystallography :

- Formation and growth of crystals; Space lattices and space groups; Derivation of 32 classes of symmetry.
- Detailed study of the six crystal systems viz., Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic, Triclinic;
- Twinning and laws of twinning,
- X-ray studies of crystals

Unit-V Optical Mineralogy:

- Isotropic and anisotropic minerals, Uniaxial and Biaxial minerals
- Refractive index, Birefringence, Pleochrism, Extinction angle, Optic aixs angle, Dispersion
- Behaviour of convergent polarized light in uniaxial and biaxial minerals.
- Optic sign determination.
- Construction and uses of Quartz wedge, Mica Plate and Gypsum plate.

Course Outcome

1. Knowledge and Classification of mineral groups.
2. Knowledge of Properties of essential minerals
3. To comprehend space lattice, space groups, crystal lattice and crystal structure
4. Understanding of optical mineralogy

SEMESTER-I
PAPER CODE: MGELCC-3
IGNEOUS PETROLOGY & GEOCHEMISTRY

Course Objective:

1. To give the basic idea of Magma, its generation and evolution
2. To study the igneous rocks classification
3. To understand the Phase system
4. To study various igneous activities in India
5. To explain geochemistry of Earth

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***

Full Marks : 70

Igneous Petrology

Unit-I

- Magma – nature, types, composition and generation.
- Magmatic evolution and differentiation: Fractional crystallization, gravitational differentiation, gas-streaming, liquid immiscibility and assimilation. Bowen's Reaction series
- Magmatism and tectonics: Inter-relationship between tectonic settings and igneous rock suites.

Unit-II

- Different schemes of Classification of igneous rocks
- Basalts – types & tectonic environments,
- Granites – types and Petrogenesis.

Unit-III

- Phase Equilibrium of single, binary, ternary silicate system.
- Phase rule and interpretation of Binary Systems with complete solid solution and also with liquid immiscibility.
- Ternary Systems
  - with congruently melting binary phases.
  - With incongruently melting binary phases.
  - With liquid immiscibility.

Unit-IV

- *Major Igneous Activities in India* – Dalma Volcanics, Malani Rhyolites, Deccan & Rajmahal volcanic.
- *General features and Petrogenetic aspects of important rock suites of India, viz.:*
  Layered Igneous Complexes, Ultramafic Rocks, Ophiolites, Anorthosites, Alkaline Rocks, Kimberlites, Carbonatites.

Geochemistry

Unit-V

- Elementary principles of Thermodynamics
- Geochemical differentiation of the Earth
- Geochemical classification of elements
- Geochemical cycle
- Application of trace elements, REEs and isotopic studies in Igneous petrology

Course Outcome

1. Knowledge of Magma generation, differentiation
2. To comprehend various classification of igneous rocks
3. Understanding concept of Phase equilbria
4. Learning of various igneous activities of India
5. Knowledge of Geochemistry

PAPER CODE: MGELCC-4 (Practical)

Course Objective:

1. To study different types of Geological Maps & Sections.
2. To learn the plotting of geological data on stereographs.
3. To understand the Minerals structure.
4. To study the methods to identify different igneous rocks.
5. To learn the optical properties of different minerals

- Geological maps and sections and problems related with them.
- Stereographic projection and their use in structural analysis
- Structural problems related with true and apparent dips, thickness of beds and three-point problem.
- Clinographic Projections of Trapezohedron, Pyritohedron, Zircon, Vesuvianite, Cassiterite, Barite, Olivine.
- Stereographic projection and determination of Axial ratio of Crystal models of Zircon, Vesuvianite, Cassiterite, Barite, Olivine,
- Determination of R.I., Scheme of Pleochroism, An-Content,
- Optic sign determination
- Megascopic and thin section study of igneous rocks
- Calculations of CIPW Norms
- Viva-Voce & Records

Course Outcome:

1. Interpret various geological structures from the study of geological maps.
2. Understand the use of stereographic projections of structural data and mineral data.
3. Gain an ability to distinguish different igneous rocks in the field and thin sections.
4. Learn to classify optical properties of the minerals.
5. Understand the importance of Geological Maps in understanding Geomorphology, Structure etc..

BOOKS RECOMMENDED

Structural Geology & Geotectonics

Condie. Kent. C., Plate **Tectonics and Crustal Evolution**, Pergamon Press

Gass I.G., **Understanding the Earth**. Artemis Press (Pvt) Ltd. U.K.

Ghos. S.K., Structural **Geology : Fundamental and Modern Development**.
Pergamon Press.

Hobbs. B.F, Means. W.D. and Williams. P.F., **An outline of Structural Geology.** John Wiley and Sons. New York

Naqvi. S.M., Geology **and Evolution of the Indian Plate (From Hadean to Holocene – 4Ga to 4Ka)**, GSI. Bangalore

Ramsay. J. G., **Folding and fracturing of rocks,** McGraw Hill.

Windley B., **the Evolving continents**. John Wiley and Sons, New York.

N. J. Price and J. W. Cosgrove, **Analysis of Geological Structures**. CUP

Turner. F.J. and Weiss, L.E. (1963): **Structural analysis of Metamorphic Tectonites** , McGraw Hill.

Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology**. **Vol. I. Strain Analysis**. Academic Press.

Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. II. Folds and Fractures.** Academic Press.

Crystallography & Mineralogy

Flint, **Crystallography**

Tutton**, Crystallography**

Dana, E.S. and Ford, W.E.: **A textobbok of Mineralogy**

Deer, W.A., Howie, R.A. & Zussman, J.: **An Introduction to the rock forming minerals,** ELBS and Longman

Berry, L.G., Mason, B. and Dietrich, R.V.: **Mineralogy**, CBS Publishers

Philips, F.C. **Introduction to Crystallography**

Kerr, P.F.: **Optical Mineralogy**

Moorhouse, W.W.: **Optical Mineralogy**

Winchell, E.N.: **Elements of Optical Mineralogy**

Nesse, D.W.: **Optical Mineralogy**, McGraw Hill.

Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. I. Strain Analysis.** Academic Press.
Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. II. Folds and Fractures.** Academic Press.

Igneous Petrology and Gechemistry

Bose, M.K., **Igneous Petrology**, World Press, Kolkata.
Best, Myron G., **Igneous and Metamorphic Petrology**, Blackwell Science.
Mason Brian , **Introduction to Geochemistry**,McGraw Hill.
Cox, K.G., Bell, J.D. and Pankhurst, R.J., **The Interpretation of Igneous Rocks**. Champman & Hall, London.
Faure, G. **Origin of Igneous Rocks**, Springer.
Hall, A., 1997 **Igneous Petrology**, Longman.
LeMaitre, R.W., **Igneous Rocks: A Classification and Glossary of Terms**, Cambridge University Press.
McBirney, **Igneous Petrology**, CBS Publishers, Delhi.
Phillpotts, A.R., **Principles of Igneous and Met24**
amorphic Petrology, Prentice Hall of India.
Sood, M.K., **Modern Igneous Petrology**. Wiley-Interscience Publ., New York.
Srivastava, Rajesh K. and Chandra, R., **Magmatism in Relation to Diverse Tectonic Settings.**
Wilson, M., **Igneous Petrogenesis**. Chapman & Hall, London.
Winter, J.D., **an Introduction to Igneous and Metamorphic Petrology**. Prentice Hall, New Jersey

SEMESTER – II
PAPER CODE: MGELCC-5
GEOMORPHOLOGY AND REMOTE SENSING & GIS

Course Objective:

1. To understand the applications of geomorphology
2. To explain the basic tools of aerial photography
3. To identify with the satellites and sensors
4. To study the techniques of image interpretation
5. To explain the concepts of GIS, DEM, etc.

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Geomorphology

Unit-I

- Principles & dynamics of Geomorphology
- Applications of geomorphology in Engineering Studies, Agriculture & Forestry, Land use planning, Mineral Prospecting, Hydrology, Environmental Studies.
- Fluvial Landforms and drainage patterns; Characteristic landforms of glacial, karst, aeolian & marine environment

Unit-II Aerial Photography, Remote Sensing and GIS

- Basic idea of Aerial Photograps & Photogrammetry
- Aerial photographs and their geometry. Errors in aerial photographs and their correction, swing, tilt, ortho photographs. Classification of aerial photographs and aerial mosaics. Photomosaics and its types. Stereoscopes: mirror and pocket stereoscope

Unit-III

- Spectral Characteristics of solar radiation. Transmittance of the atmosphere. Spectral reflectance of land covers. RS Satellite characteristics-orbits and swaths. Sensors used in remote sensing.

Unit-IV

- Principles of Remote Sensing, Polar orbiting Remote Sensing & Geostationary satellites.
- Digital Image processing, Digital processing techniques, Georeferencing, digital image classification and image enhancement, spatial filtering, band ratioing, FCCs, principal component analysis, IHS and NDVI images, supervised and unsupervised classification and its utility in land-cover mapping.

Unit-V

- Introduction to GIS and its components. Raster and Vector data. Functions of GIS. Data integration and overlay analysis in GIS.
- Digital Elevation Model Concept.
- Principles and application of GIS and RS in geohazards monitoring (landslides, floods, droughts, cyclones, earthquakes).
- Global Positioning system

Course Outcome

1. Students shall have a comprehensive understanding of landforms
2. Knowledge of aerial photography techniques
3. Application RS and GIS
4. Importance of GPS

SEMESTER – II
PAPER CODE: MGELCC-6
SEDIMENTOLOGY

Course Objective:

1. To understand and appreciate the sedimentary processes.
2. To understand the environment and facies of sedimentary deposition.
3. To examine properties of sedimentary rocks and their nomenclature.
4. To unravel the relationship between different sedimentary basins and tectonics.

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***

Full Marks : 70

Unit-I

- Sedimentary Processes – weathering ,sediment transport and deposition.
- Lithification and diagenesis – principles
- Concept of flow regimes and bedforms. Types of fluids, Laminar vs. turbulent flow, Reynolds number, Froude Number, Boundary layer effect, Particle entrainment, sediment gravity flows.

Unit-II

- Texture of sedimentary rocks – grade scales, graphical representation and statistical analysis, sphericity, roundness, porosity & permeability.Concept of textural and compositional maturity.
- Sedimentary structures – their origin ,types and geological significance .
- Paleocurrent analysis

Unit-III

- Classification of sedimentary rocks
- Clastic Sedimentary Rocks – origin and classification
- Non-clastic Sedimentary Rocks – origin and classification

Unit-IV

- Environment of sedimentation : Parameters, Classification, and Characteristics
- Sedimentary environments : terrestrial, coastal and marine
- Sedimentary facies : Orthoquartzite, Carbonate, Red Beds, Euxenic, Molasse, Flysch, and Sabkha facies.

Unit-V

- Heavy minerals- heavy minerals as indicators of provenance
- Tectonics and Sedimentation.
- Sedimentary basins and their classification
- Sedimentary basins of India

Course Outcome

1. Students will be able to understand the process of formation of sedimentary rocks.
2. They will interpret dynamics of depositional environments.
3. Enable Students to evaluate the record of tectonic & climatic processes through geological time.

SEMESTER – II
PAPER CODE: MGELCC-7
METAMORPHIC PETROLOGY

Course Objective:

1. To understand the concept of Metamorphism
2. To explain the fundamentals of metamorphic facies
3. To study chemographic diagrams and metamorphic reactions
4. To study the metamorphism of various rock types
5. To learn about different metamorphic terrains

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Unit-I

- Metamorphism – Definition and types and their controlling factors .
- Metamorphism - Texture & Structure
- Metasomatism- Definition and types

Unit-II

- Classification of Metamorphic Rocks.
- Metamorphic Differentiation.
- Plate Tectonics and metamorphism.
- Metamorphic Facies – Concept and classification; Facies Series.

Unit-III

- Mineralogical Phase Rule.
- Chemographics Diagrams :ACF, AKF and AFM .
- Isograds and Nature of Metamorphic Reactions
- Schrienemakers Rule and construction of Petrogenetic Grids P-T-t Paths

Unit-IV

- Regional and Contact metamorphism of pelitic rocks.
- Regional and Contact metamorphism of carbonate rocks
- Metamorphism of basic and ultrabasic rocks

Unit-V

- Metamorphism of Granitoides, Charnockites and Migmatites
- Paired metamorphic belts
- Archaean and Proterozoic terrains

Course Outcome

1. Understanding of metamorphism and its products
2. Knowledge of relation between plate tectonics and metamorphic facies
3. Importance of isograds and metamorphic reactions
4. Learning about the metamorphic products
5. Knowledge of paired metamorphic belts and metasomatism

SEMESTER – II
PAPER CODE : MGELCC-8
STRATIGRAPHY AND PALAEONTOLOGY (I)

Course Objective:

1. To visualize the basics of stratigraphic nomenclature & methods.
2. To unravel the oldest rocks sequences & their distribution in India.
3. To introduce deposition & tectonics of Precambrian regions of India.
4. To understand the fundamentals of Biostratigraphy , organic evolution & Mammals in India.

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Stratigraphy:

Unit-I

- Principles of stratigraphy and startigraphic correlation
- Stratigraphic classification & Nomenclature viz. Lithostratigraphic, Biostratigraphic- and Chronostratigraphic units
- Facies Concept
- Brief study of seismic stratigraphy, magneto stratigraphy, and sequence stratigraphy

Unit-II

- Formation of early crust, greenstone – granulite belts, subdivisions of Precambrian
- Archaean Stratigraphy :
  - Structure, tectonics & Stratigraphy of Singhbhum craton
  - Structure & tectonics of Dharwar craton
  - Bundelkhand Granite gneiss complex
  - Stratigraphy of central India – Sausar, Sakoli and Chilpi Groups.
- Archaean – Proterozoic Boundary

Unit-III

Proterozoic Stratigraphy :

- Stratigraphy of Cuddapah – Kurnool Supergroup and equivalents
- Vindhyans – sedimentation, life, stratigraphy and economic importance
- Stratigraphy, sedimentation, tectonics and evolution of Delhi-Aravalli supergroup, Kolhan Group.
- Precambrian – Cambrian Boundary

Palaeontology:

Unit-IV

- Principles and divisions of Palaeontology
- Fossilisation – Preservation & Taphonomy
- Palynomorphs & Ichnofossils (in brief)
- Origin of life ; Life through the Ages
- Organic Evolution -- theories and evidences
- Mechanism and Modes of evolution
- Mass Extinctions & their causes

Unit-V

Invertebrate Palaeontology :

- Morphology and evolutionary trends in:
  - Brachiopods,
  - Molluscs- Gastropoda, Pelecypoda, Cephalopoda
  - Trilobites
  - Echinodermata
  - Graptolites,

Course Outcome

1. Students shall benefit in their idea of various stratigraphic tools.
2. A better understanding of the oldest rocks & their associations.
3. A comprehensive idea of Aravalli, Cuddapah & Vindhyan rocks & their significance,
4. An understanding of origin & extinction of life forms and the vertebrate & Mammalian life.

PAPER CODE: MGELCC-9 (PRACTICAL)

Course Objective:

1. To study the sedimentary and metamorphic rocks.
2. To understand the use of satellite data in interpreting geology of the area.
3. To learn the application of latest software in geological studies.
4. To identify different kind of fossils and their stratigraphic importance.
5. To study Palaeogeographic maps of India.

- Field techniques
- Megascopic and thin section study of sedimentary rocks
- Megascopic and thin section study of metamorphic rocks
- Analysis of satellite data in different bands and interpretations of various objects on the base of their spectral signature
- Introduction to DIP and GIS software

- Identification of vertebrates, invertebrates, plant fossils & microfossils.
- Identification of stratigraphic rocks of important stratigraphic horizons of India.
- Study of Palaeogeographic & Stratigraphic maps of India for different geological periods.
- Viva-Voce & Sessional records.
-

Course Outcome:

1. Identification of the different sedimentary and metamorphic rocks.
2. Enable students to use satellite data in interpreting geology of the area.
3. Learn latest software and its use in solving geological problems.
4. Identify different kind of fossils and their stratigraphic importance.
5. Learn the position of India on a Global Map in different geological time.

Books Recommended:

Geomorphology:

Thornbury, W.D. 1980: **Principles of Geomorphology**. Wiley Easton Ltd., NY
Holmes, A. 1992: Holmes **Principles of Physical Geology** Edited by P. McL. D. Duff. Chapman and Hall, London.
Halis, J.R. 1983: **Applied Geomorphology**
Sharma, H.S. 1990: **Indian Geomorphology**. Concept Publishing Co New Delhi
Singh, S., **Geomorphology**
Kale & Gupta, **Introduction of geomorphology**
Sen and Prasad, **Geomorphology of India**
Mahadevan, T. M. , **Geology of Bihar & Jharkhand**

Photogeology & Remote Sensing

Pandey, Shiv N., **Principles and Applications of Photogeology**, Wiley Eastern.
Joseph, George. **Fundamentals of Remote Sensing**, University Press (India)
Jensen, John R., **Remote Sensing of the Environment**, Prentice Hall
Cracknell, A. P. & Hayes, L. B. W., Introduction **of Remote sensing**, Jaylor & Francis.
Lille Sand & Koefes, **Remote Sensing & Image Interpretation** –John Wiley
Curran, Paul J., **Principles of Remote Sensing**, ELBs
Drury, S. A., **Image interpretation in Geology**, Allen & Unwin.
Bruns & Francs, **Photogeology** , Oxford & IBH.

Metamorphic Petrology

Winter, J.D., **An Introduction to Igneous and Metamorphic Petrology**. Prentice Hall, New Jersey.

Turner. F.J. and Weiss, L.E. (1963): **Structural analysis of Metamorphic Tectonites** , McGraw Hill.
Winter, J.D. 2001 **An introduction to Igneous and Metamorphic Petrology**, Prentice Hall.
Bucher, K. and Martin, F. 2002 **Petrogenesis of Metamorphic Rocks**, Springer – Verlag, 7th Edition.
Yardlley, B.W.D. 1989 **An introduction to Metamorphic Petrology**, Longman, New York.
Rastogy, R.P. and Mishra, R.R. 1993: **An Introduction to Chemical Thermodynamics,** Vikash Publishing House.
Yardley, B.W.D., Mackenzie, W.S. and Guilford, C. 1995 **Atlas of Metamorphic Rocks and their textures,** Longman Scientific & Technical, England.
Spry, A. 1976 **Metamorphic Textures**, Pergamon Press.
Blatt, H. and Tracy, R.J. 1996 **Petrology (Igneous, Sedimentary, Metamorphic),** W.H. Freeman & Co.

Sedimentology

Blatt, H., Middleton, G.V. and Murray, R.C. (1980): **Origin of Sedimentary Rocks,** Prentice-Hall Inc.
Collins, J.D., and Thompson, D.B. (1982): **Sedimentary Strucutres**. George Allen & Unwin, London.
Lindholm, R.C. (1987) **A Practical Approach to Sedimentology**. Allen & unwin, London.
Miall, A.D. (2000): **Principles of Basin Analysis**, Sjpringer-Verlag.
Pettijohn;, F.J. (1975): **Sedimentary Rocks**. 3rd Edn. Harper and Row Publ., New Delhi.
Reading, H.E. and Singh, I.B. (1973):**Depositional Sedimentary Environments**. Springer-Verlag.
Selley, R.C. (2000) **Applied Sedimentology**, Academic Press.
Tucker, M.E. (1981): **Sedimentary Petrology: An Introduction**, Wiley & Sons, New York.
Tucker, M.E. (1990): **Carbonate Sedimentology**, Blackwell Scientific Publication.

Stratigraphy

Naqvi, S.M. and Rogers, J.J.W. (1987) **Precambrian Geology of India**. Oxford University Press
Krishnan, M.S. (1982) **Geology of India and Burma**. C.B.S. Publishers & Distributors, Delhi
Pascoe, E.H. (1968) **A Manual of the Geology of India & Burma** (Vols I-IV) Govt. Of India Press, Delhi
Schoch, Robert, M. (1989) **Stratigraphy: Principles and Methods**, Van Nostrand Reinhold, New York
Doyle, P. & Bennett. M.R. (1996) **Unlocking the Stratigraphic Record** (John Villey)
Weller, J. Marvin (1960) **Stratigraphic Principles & Practice**, Harper & Row Publishers New York & London
Wadia, D.N. **Geology of India**, Tata McGraw-Hill Publishing Co, N. Delhi
Lemon Roy R. (1990) **Principles of stratigraphy**, Herrill Publishing Company
Kumar Rabindra, **Fundamentals of Historical Geology and Stratigraphy of India**, wiley Eastern Ltd, N. Delhi
Sharma, P.V., 1986, **Geophysical Methods in Geology,** Elsevler.
Dobrin, M.B. 1976, **Introduction to Geophysical Prospecting**. McCraw Hill.
Wolf, K.H., 1076-81 : **Hand Book of Stratabound and Stratiform Ore Deposits**. Elsevier.
Klemm, D.D. and sohneider, H.J., 1977 – **Time and Strata Bound Ore Deposits**. Springer Verlag.

Palaeontology

Woods, H. – **Invertebrate Palnentology**.
Eorley and Davis, A.M. – **Introduction to Palaeontology**
Swinerton, H.H. – **Outline of Palaneontology**.
Shrock, R. T. and Towenhofel, W.H. – **Invertebrate Palaeontology**.
Lull – **Organic Evolution**.
Steam, C.W. abd Carroll, R.L., 1989 – **Palaeontology – the Record of Life**. John Willey.
Romer, A.S., 1966; **Vertebrate Palaeontology** (3rd Edn.) Chicago Univ. Press.
Olson, E.C., 1971 – **Vertebrate Palaeozoology**. John Wiley.
Benton, M.J., 1990 – **Vertebrate Palaeontolozy**, Union Yman.
Arnold, C.A., 1947 – **An Introduction to Palaeobotany**. McGraw Hill.
Andrews, Jr. Bell. 1961 – **Studies in Palaeobotany**. John Wiley.
Saward, A.e., 1931 – **Plant Life through the Ages**. Cambridge Univ. Press.
Hynes, J.R. 1981 – **Foraminifera**, John Wiley.
Bignot, G., 1985 – **Elements of Micropalaeontolgoy**. Uraham and Trotman.
Boardman R.S.. Cheethan. A.M. and Rowell. A.J. (1988) : **Fossil Invertebrates**. Blackwell.
Clarkson. E.N.K. (1998) : **Invertebrate Paleontology and Evolution**. Allen and Unwin, London.
Raup. D.M. and Stanley, S.M. (1985) : **Principles of Paleontology**. CBS Publ.
Smith. A.B. (19947):**Systematics andFossil Recored–Documenting Evolutionary Patterns.**Black well.
Shrock R.R. (1953) **Principles of Invertebrate Paleontology**, Mc Graw Hill Book Co.

SEMESTER – III
PAPER CODE: MGELCC-10
ENVIRONMENTAL GEOLOGY & HYDROGEOLOGY

Course Objective:

1. To acquire the knowledge of Hydrological cycle and its components.
2. Learning techniques of ground water exploration and ground water provinces.
3. To introduce the concept of Environmental geology and ecosystem.
4. To understand Environmental Impact of urbanization, mining , waste disposal and various environmental legislations

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***

Full Marks : 70

Hydrogeology:

Unit-I

- Hydrological cycle & the role of groundwater in the cycle.
- Aquifers and their types; Springs
- Hydrological Properties of water-bearing formations- porosity, permeability, transmissibility, storage coefficient, specific yield, specific retention

Unit- II

- Groundwater exploration: geological and geophysical methods.
- Rain water harvesting & Artificial recharge.
- Groundwater provinces of India; Groundwater resources of Bihar.
- Groundwater quality: physical and chemical characteristics; arsenic and fluoride contamination.

Environmental Geology

Unit-III

- Concept of Environmental Geology
- Basics of natural Ecosystem on the Earth and their mutual interrelation & interaction with Atmosphere, Hydrosphere, Lithosphere & Biosphere.
- Natural Hazards and their mitigation– Floods, Landslides Coastal Hazard, Earthquake , Cyclones, Storms

Unit- IV

- Elements of Environmental Impact Assessment
- Environmental impact of urbanization, open cast mining and radioactive waste disposal.
- Impact assessment of degradation & contamination of water quality due to industrialization & urbanization.
- Environmental Legislations in India..

Unit-V

- Soil profile & soil quality degradation due to irrigation, fertilizer and pesticides.
- A brief study of the following :
  - Disposal of solid waste
  - Pollution of rivers
  - Conservation of mineral resources.
  - Global warming and sea level changes

Course Outcome

1. Knowledge of hydrological properties of aquifers
2. To study techniques of ground water exploration and water quality
3. Understanding of Hydrosphere, Lithosphere and Biosphere
4. Knowledge of EIA and Environmental legislations
5. Study of Environmental Issues

SEMESTER – III
PAPER CODE: MGELCC-11
ENGINEERING GEOLOGY & GEO-EXPLORATION

Course Objective:

1. To give the concept of Engineering geology and Rock mass characterization.
2. To study different types of engineering structures
3. To study the stability and investigation process.
4. To know about different type of exploration
5. To study different types of geophysical survey.

The pattern of question papers will be as under

Group A – Compulsory – Ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Engineering Geology

Unit-I

- Concept of Engineering Geology (Stages of Investigation).
- Role of Engineering Geologists.
- Engineering properties of rocks and their determination.
- Rock mass Classification, Rating, Quality Determination and Characterization; Strain and strength of rock

Unit-II

- Ground Investigation: Boreholes and Trial Pits; Drilling, Drifting, Sampling and Logging.
- Stability of Hill Slopes, Landslides Factor of Safety and Probability of Failure.
- Various strength tests; Effect of discontinuities on Rock Mass Strength.

Unit-III

- Geotechnical considerations in the constructions of Dams, Reservoirs and Spillways; Tunnels; Powerhouses; Bridges; Highways;
- Geotechnical treatments including Grouting and Rock Bolting; Foundation Treatment.
- Geotechnical case studies of major projects in India.

Geo-Exploration

Unit –IV

- Geochemical exploration- nature of samples anomaly, strength of anomaly and controlling factors, coefficient of aqueous migration .
- Geobotanical prospecting.

Unit –V
Geophysical Prospecting

- Gravity method:. Corrections applied to gravity data. Derivation of Free-Air and Bouguer Gravity anomaly maps;
- Magnetic anomalies. Interpretation of magnetic anomalies-Direct interpretation, Indirect interpretation;
- Electrical Resistivity method :.Basic principles, Field procedures: Profiling and Sounding. Applications of electrical methods in groundwater prospecting and civil engineering problems
- Seismic methods: Principles and applications

Course Outcome

1. Understanding of role of geologists in the construction of civil structures
2. To investigate Rock Mass characterization and classification
3. To understand different types of engineering structures and techniques
4. To know different types of Exploration methods.
5. Students shall have a solid understanding of techniques of investigations for engineering projects.

SEMESTER – III
PAPER CODE: MGELCC-12
ECONOMIC GEOLOGY

Course Objective:

1. To study mineral deposits and processes of formation of deposits.
2. To study Mineral Economics and related Legislations
3. To study the nature of different mineral deposits.
4. To know genesis and distribution of major ore minerals.
5. To give concept of Coal and Petroleum geology.

The pattern of question papers will be as under

Group A – Compulsory – Ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Unit-I

- Classification of mineral deposits
- Processes of formation of mineral deposits – Magmatic Concentration, Oxidation and Supergene Sulphide Enrichment, Hydrothermal, Residual & Mechanical concentartion

Unit- II

- Mineral Economics : concept & significance
- Mineral beneficiation & Ore-dressing
- Controls of Ore localization
- Mineral paragenesis & Zoning
- Metallogenetic epochs & provinces with special reference to India;
- Conservation of minerals : Strategic, Critical & Essential minerals.
- National Mineral Policy; Law of the Sea beds for marine mineral resources.

Unit-III

- Plate Tectonics & Metallogeny
- Study of host rock- lithology, mineralogy, tectonic setting and distribution in time & space of :
    - Porphyry copper; Volcanogenic massive sulphide deposits; Sediment – hosted base metal deposits ; BIF's; Skarn deposits

Unit-IV

- Occurrence, distribution, genesis & uses of metallic/non-metallic minerals of India: Iron, Copper, Lead-Zinc, Manganese, Chromite, Bauxite, Mica, Gold, Atomic minerals, Abrasives & Refractory minerals.

Unit-V

- Coal : Definition and Chemical aspects of coal (Proximate & ultimate analysis)
- Origin of coal; Classification of coal
- Coal Petrography (in brief)
- Distribution of coal in India
- Coal Bed Methane – basic idea.
- Origin of Petroleum
- Migration & Accumulation of Oil
- Reservoir Rocks and Traps, Oil Shales
- Petroliferous basins of India.

Course Outcome

1. Students will have understanding of classification of Mineral deposits and processes of formation.
2. To have a knowledge of Mineral Economics and related Legislations
3. A comprehensive idea about Genesis and distribution of major ore minerals and associated host rocks.
4. A basic understanding of occurrence and origin of Fuel deposits with reference to India.

SEMESTER – III
PAPER CODE: MGELCC-13
STRATIGRAPHY AND PALAEONTOLOGY (II)

Course Objective:

1. To study Paleozoic Era stratiraphy
2. To know about various rock formations of Mesozoic Era
3. To learn about the importance of Cenozoic Era
4. Learning of Invertebrate Paleontology
5. Learning the significance of flora and importance of microfossils

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***

Full Marks : 70

Unit-I

Palaeozoic Stratigraphy

- Cambrian succession in Salt Range; Age of Saline Series
- Cambrian of Spiti & Kashmir
- Muth Quartzite, Lipak and Po Series
- Gondwana- stratigraphy, sedimentation, life, climate and economic importance
- Permo-Carboniferous : stratigraphy and paleogeography
- Permian – Triassic (P-T) boundary

Unit-II

Mesozoic Stratigraphy

- Triassic formations of India
- Jurassic formations of Kutch
- Marine Trangressions ; Cretaceous formations of South India
- Palaeogeography & Climate conditions during Cretaceous periods.

Unit-III

Caenozoic Stratigraphy

- Deccan Traps & Intertrappeans
- Tertiary formations of India
- Siwalik System- stratigraphy and sedimentation
- Cretaceous-Tertiary (K-T) Boundary

Unit-IV

- Classification and account of vertebrate life during geological time
- Siwalik mammals & causes of their extinction
- Evolutionary trends in
    - Homosapiens,
    - Equidae, &
    - Proboscidae.

Unit-V

- Vascular & Non-vascular plants
- Gondwana Flora in India.
- Fundamental ecological principles
- Marine Ecosystem; Fossil communities, Coral Reefs
- Introduction to Microfossil groups
- Sampling & processing techniques for microfossil studies
- Brief idea of Foraminifera & Radiolarians
- Application of microfossil studies in Correlation, Petroleum exploration, Palaeo-climate & oceanographic studies

Course Outcome:

1. Evidence for changes in the form of oceans and continents
2. Global and local climate and environment in which different forms of life evolved
3. To unravel the events of the past
4. To determine the order in which the rocks were formed
5. To understand morphology and evolutionary trends of fauna and flora

PAPER CODE: MGELCC-14 (Practical)

Course Objective:

1. To study the Economic Minerals
2. To classify and characterize rock mass.
3. To Study the hydrological properties of the rock.
4. To study different types of fossils and their geological importance.
5. To apply the geological principles in the field.

- Megascopic study of economic minerals
- Location of ground water provinces on outline map of India
- Chemical analysis of water and study of hydrological properties of rocks.
- Identification of vertebrates, invertebrates, plant fossils & microfossils.

- Identification of stratigraphic rocks of important stratigraphic horizons of India.
- Study of Palaeogeographic & stratigraphic maps of India for different geological periods.
- Numericals related to strength properties, core logging
- Field Report records & Viva-voce.

Course Outcome:

1. Identify the Economic Minerals based on their distinguishing properties
2. A comprehensive idea of the Rock Mass Classification
3. Identify the different kinds of Fossils – vertebrate, invertebrate, plants.
4. To develop an idea of Determination of the hydrological properties of rock.
5. An understanding of the location of ground water provinces of India.

BOOKS RECOMMENDED

Hydrogeology

Todd, D.K. **Groundwater Hydrology**. John Wiley.
Davies, S.N. and Dewiest, R.J.M. – **Hydrogeology**, John wiley.
Fetter, C.W. **Applied Hydrogeoloy**, Merill Publishing.
Raghunath, H.M. – **Ground water**. – Wiley Eastern.
Karanth. K.R. – **Groundwater Assessment – Development and Management**. Tata Mc. Grew Hill.
Krynine. D.H. and Judd, W.R. – **Principles of Engineering Geology**, CBS Edition.
Valdiya, K.S., **Environmental Geology- Indian context**, Tata McGraw Hill
Keller, E. A., **Environmental Geology**, Bell & Howell, USA
Subramaniam, V., **Textbook in Environmental Science**, Narosa International
Smith, K. , **Environmental Hazards**, Routledge, London

Economic Geology

Facal, Z.. (ed), 1977 – **Geochemical Prospecting Methods**.
Bateman – **Economic Geology**.
Gilbert. J. M. and Park, Jr. C.F. – **The Geology of Ore Deposits**. Freeman.
Mckinstry, H.E. – **Mining Geology**. IIED Asia Publishing House.
Arogyaswami, R.P.N. – **Courses in Mining Geology**. IV ed. Oxford IBH
Barroah, S.K. – **Economic Mineral Deposits of India**.
Brown, C. and Dey, A.K. – **Indian Mineral wealth**.
Edwards, H. and Atkinson, K. – **Ore Deposit Geology**.
Sowking, F.J. – **Metal Deposits in relation to Plate Tectonics**.
Evans, A.M. (1993) **Ore Geology and Industrial Minerals**, Blackwell
Stanton, R.L. (1972) **Ore Petrology**, McGraw Hill
Barnes, H.L. (1979) **Geochemistry of Hydrothermal Ore Deposits**, John Wiley
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Engineering Geology

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SEMESTER – IV
PAPER CODE: MGELEC-1
ADV. HYDROGEOLOGY (Elective paper)

Course Objective:

1. To study distribution of water on earth, water fluctuations and ground water pollution
2. To solve flow equations
3. Study of groundwater exploration methods and mapping
4. Learning of various drilling methods, pump tests and water conservation methods
5. Learning the water quality criteria

The pattern of question papers will be as under

Group A – Compulsory – Ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***

Full Marks : 70

Unit I :

- Distribution of water on the Earth- World's total water supply,
- Origin of water : meteoric, juvenile, connate, magmatic and sea water; Hydrologic cycle
- Age of Ground Water; Hydrographs; Water table contour maps; water level measurements
- Subsurface movement and vertical distribution of groundwater;
- Water table fluctuations- causative factors; Concept of barometric and tidal efficiencies.
- Ground water pollution; Attenuation of groundwater pollution;
- Saline water intrusion in coastal and other aquifers and its prevention

Unit II :

- Geologic formations as aquifers;
- Hydrostratigraphic units.
- Theory of groundwater flow;
- General flow equations, steady unidirectional flow, steady radial flow to a well, unsteady radial flow in confined and unconfined aquifers;
- Darcy's Law and its applications; Permeability and its determination in laboratory and in field; Hydraulic conductivity and its determination; Groundwater tracers.

Unit III :

- Groundwater exploration **:** Geological, lithological and structural mapping, fracture, stress analysis;
- Surface geophysical methods- seismic, gravity, geo-electrical and magnetic.
- Subsurface geophysical methods- well logging for delineation of aquifers. Water level measurement;
- Hydrogeomorphic mapping of the terrain using images of different satellite missions;
- Shallow groundwater potential zones mapping using satellite images;

Unit IV :

- Water well technology : Well types; drilling methods;
- Construction, design, development and maintenance of wells,
- Specific capacity and its determination;
- Pump test- methods, data analysis and interpretation for hydrologic boundaries;
- Groundwater modelling- numerical and electrical methods.
- Water Conservation , Rainwater Harvesting : catchment harvesting, harvesting structures. Check dams, percolation tanks;
- Artificial recharge; Conjunctive use of surface & subsurface water;
- Groundwater development in arid and semi-arid regions;

Unit V :

- Groundwater quality- physical and chemical characteristics of groundwater, Chemical analysis; Changes in chemical composition;
- Water quality criteria for domestic, irrigational and industrial uses;
- Graphical representation of water quality data;
- Groundwater provinces of India with special reference to Bihar;
- Groundwater management in urban & rural areas.Groundwater problems related to foundation work, mining, canals and tunnels;
- Groundwater legislation

Course Outcome:

1. Knowledge of water distribution and types
2. Understanding the significance of various Hydrostratigraphic units and theory of ground water flow
3. Hydrogeomorphic mapping for potential zones
4. Knowledge of Well hydraulics
5. Analysis of Ground water quality and concept of ground water management

SEMESTER – IV
PAPER CODE: MGELEC-1
FUEL GEOLOGY (Elective Paper)

Course Objective:

1. To educate about classification and petrography of coal
2. To detail the various methods of utilization of coals
3. To outline basic techniques of oil/gas production from coal
4. To deliberate upon the generation and entrapment of oil
5. To highlight the methods of oil exploration and distribution of petroliferous basins in India

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Unit-I

- Fundamentals; sedimentology & structures in coal-bearing strata
- Classification of coal
  - Indian & International classifications
  - Seyler's classification
- Coal Petrography – Lithotypes (Banded Constituents of coal)
  --Microscopic constituents (Macerals & micro-lithotypes)
- Vitrinite reflectance ; Applications of Coal Petrography

Unit-II

- Origin of coals – Thories and changes in Peatification and coalification
- Concept of Coal Rank and grade; Industrial grades of coal
- Coal carbonization
- Coal washing – types & methods
- Coal Mining methods; acid mine drainage

Unit-III

- Coal combustion
- Coal Hydrogenation & Gasification;
- Coal Bed Methane (CBM)
- Distribution of Gondwana & Tertiary coal in India; lignites deposits in India
- Coal Exploration & Coal industry in India

Unit-IV

- Source rocks – nature, types & characteristics
- Kerogen – composition & types
- Organic matter accumulation, maturation process & generation of HC
- Migration and Accumulation of Petroleum
- Reservoir Rocks;
- Reservoir Traps – Structural, Stratigraphic & Mixed Traps, Salt Domes

Unit- V

- Elementary idea of well logging and drilling
- Methods of Petroleum Exploration- geological & geophysical
- Fundamental concepts of Sequence Stratigraphy
  Utility of microfossils in Oil exploration
- Oil shales, Shale gas, Gas hydrates
- Petroliferous Basins of India- Digboi, Cambay, Bombay High Basin, East coast basins
- Present investigations and future prospects of Oil and Gas in India

Course Outcome:

1. Students shall benefit to have basic ideas about formations, nomenclature in constitution of coal
2. Development of comprehensive knowledge of utilization of coals
3. A working detail of distribution of coals and coal industry in India
4. Sufficient idea of formation and entrapment of oil and gas
5 Elaborate understanding of oil exploration techniques and petroliferous basins of India

SEMESTER – IV
PAPER CODE: MGELEC-1
ADVANCED SEDIMENTOLOGY (Elective Paper)

Course Objective:

1. To understand and appreciate the sedimentary processes.
2. To know the economic importance of fossil fuels and other essential minerals
3. To learn to examine sedimentary rocks.
4. To train them to unravel the chain of events responsible for production of particular stratigraphic sequence.

The pattern of question papers will be as under

Group A – Compulsory – Ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Unit-I

- Formation of Sedimentary rocks: Weathering, transportation, deposition , lithification and diagenesis.
- Sedimentary Environment – Physical, Chemical & Biological parameters, Classification
- Study of characteristics of sediment fill of Aeolian, Fluvial, Glacial and Marine environments

Unit-II

- Application of modern methods & techniques in the study of sediments
- Sampling, principles & methods of size-analysis – Stoke's Law, Wadell's sedimentation formula
- Reynold's Numbers, Froude's Number, Sedimentary Gravity flow
- Study of mass properties of sediments: Colour, porosity, permeability, plasticity, hygroscopicity, adsorption, & tensile strength
- Bearing of sedimentary petrography on palaeo-geographical problems

Unit-III

- Texture of clastic sedimentary rocks: concept of grain size, grain morphology – roundness and sphericity, grain fabric; grade scales.
- Statistical analysis and Graphical representation of analytical data
- Sedimentary structures: Classification; primary inorganic structures – erosional, syn-depositional & deformational, chemical/diagenetic structures, biogenic structures and their geological significance.
- Paleocurrent analysis

Unit-IV

- Sandstone – classification, type and origin,
- Limestone – classification, type and origin;
- Dolomitization and dedolomitization
- Concept of sedimentary facies association
- Study of Orthoquartzite-Carbonate, Molasse, Flysch, Euxenic, Red-Bed, Black shale & Sabkha facies

Unit-V

- Provenance –Concept of maturity of sediments, mobility of oxides and Role of heavy minerals in provenance determination
- Sedimentary basins : Concept & Classification
- Sedimentation & Tectonics
- Application of Sedimentology in
  - Petroleum geology
  - Geohydrology
  - Environmental geology
- Sedimentological study of
  - Vindhyan Basin
  - Gondwana Basin
  - Siwalik Basin

Course Outcome

1. Students will be able to understand the process of formation of sedimentary rocks.
2. They will interpret dynamics of depositional environments.
3. Students will be able to critically evaluate the record of tectonic and climatic processes through geological time.

SEMESTER – IV
PAPER CODE: MGELEC-1
GEOCHEMISTRY (Elective Paper)

Course Objective:

1. To educate about fundamentals of the universe.
2. To detail the various aspect of geochemistry.
3. To outline relationship between petrology and geochemistry.
4. Inter-relation between different spheres.
5. To highlight the application of geochemistry for industrial purpose.

The pattern of question papers will be as under

Group A – Compulsory – Ten questions (two from each unit) of 2 marks each, ***2×10 = 20 marks***
Group B –Five questions (one from each unit) of 5 marks each, four to be answered, ***5×4 = 20 marks***
Group C –Five questions (one from each unit) of 10 marks each, three to be answered ***10x3= 30 marks***
Full Marks : 70

Unit-I

- Earth in relation to solar system and universe
- Cosmic abundance of the elements: Oddo-Harkins principle.
- Meteorites –classification, mineralogy, chemical composition
- Geochemical evolution of the earth
- Structure and composition of the earth

Unit-II

- Geochemical cycle
- Geochemical classification of elements and its distribution
- Fundamentals of thermodynamics
- Isotope geochemistry – stable and unstable isotopes
- Geochronolgy and Age of the Earth .
- Principles of isotope dating

Unit –III

- Magmatism as a geochemical processes
  -Chemical composition of magma and igneous rock
  -minor/trace elements in magmatic crystallization
- Sedimentation as a geochemical processes
  -Physico-chemical factors in sedimentation; H ion concentration; Oxidation-Reduction potential;
- Metamorphism as a geochemical processes
  -Chemical composition of metamorphic rocks
  -mineral transformation and facies principle

Unit – IV

Geochemistry of atmosphere, hydrosphere & biosphere

- Composition of the atmosphere
- Constancy of atmospheric composition; Variable constituents of the atmosphere
- Nature and composition of the sea water and terrestrial water hydrosphere
- The balance of the dissolved matter in the sea water
- The nature and mass of the biosphere and its composition
- An elementary idea of the biogenic deposits

Unit – V

- Principles of geochemical prospecting; Primary and secondary dispersion patterns
- Pathfinder elements ; Geochemical anomalies
- Geochemical sampling, field and analytical techniques.

Course Outcome:

1) Students shall benefit to have basic ideas about the Universe and the Earth.
2) Development of comprehensive knowledge of the application of geochemistry.
3) Understanding about the petrology and the chemistry behind it.
4) Enhancement of knowledge regarding the Earth & its different spheres.
5) Knowledge of geochemistry for industrial purpose.

BOOKS RECOMMENDED

Adv. Hydrogeology (Elective)

Raghunath, H. M., **Ground Water**, New Age International Publishers;
Todd, D. K., **Groundwater Hydrology**, John Wiley & Sons;
Mandel, S. & Shiftan, Z. N., **Groundwater Resources : Investigations and Development** , Academic Press;
Manning, John C, **Applied Principles of Hydrology**, CBS Publishers;
LaMoreaux, Soliman, Memon & Assaaad, **Environmental Hydrogeology,**
Grigg, Neil S, **Water Resources Management,** McGraw Hill;
Das & Saikia, **Hydrology,** PHI Learning Pvt Ltd ;
Handa, O.P., **Groundwater Drilling**, Oxford &IBH Publishing Co.;
Ravenscroff, Brammer & Richards, **Arsenic Pollution**, Willey- Blackwell;
Davies, S.N. and Dewiest, R.J.M. – **Hydrogeology**, John wiley.
Fetter, C.W. **Applied Hydrogeology**, Merill Publishing.
Karanth. K.R. – **Groundwater Assessment – Development and Management**. Tata Mc. Grew Hill.

Fuel Geology (Elective)

Colin R. Ward(Edited), **Coal Geology and Technology**.
Wilcon and Wells , **Coal, Coke and Coal chemical**
Coggin Brown and A.K. Dey **Mineral and Nucloar Fuels of Indian Subsontinent** -.
A. I. Levorsen , **Geology of Petroleum** .
F.K. North , **Petroleum Geology** , (Publishers- Allen and Unwiry.)
Petroliferous Basins of India – 1993-94 (3 volumes), Indian Petroleum Publisers, Dehradun.
Chendra, D. Singh, R.M. and Singh, M.P. 2000. **Textbook of Coal** (Indian Context). Tara Book Agency. Raranesi.
Singh, M.P. (Ed.) 1998 – **Coal and Organic Petrology**. Publ. Corp. New Delhi.
Holson, G.D. and Tiratsoo, E.N., 1985. **Introduction to Petroleum Geology**. Gulf Publ. Houston, Texas.
Selley, R.C., 1998, **Elements of Petroleum Geology**. Academic Eress.
North, F.K., 1985, **Petroleum Geology**, Allen and Unain.
Tissot B.P. and Welge, D.ll., 1986, **Petroleum Formation Occurrence** Springer Verlag.

Advanced Sedimentology (Elective)

Pettijohn – F.J., **Sedimentary Rocks**,
Selley, R.C., **Applied Sedimentology**, Academic Press
Reineck, H.E, and Singh, I.B., **Depositional Sedinentary Environments**. Springer – Verlag.
Tucker, M.E., **Sedimentary Petrology : An Introduction**, Wilay & Sons, New York
Tucker, M.E, **Carbonate Sedimentology**, Blackwell Scientific Publication
Reading, H.G., **Sedimentary Environments and Facies**, Blackwell Scientific Publication
Blatt, H., Middletoy, G.V. and Murray, R.C, **Origin of sedimentary Rocks**, Prentice – Hall Inc.
Colling, J.D. and Thompson, D.B., **Sedimentary structures**. George Allen & Unwin, London.
Miall, A.D. (2000) **Principles of Basin Analysis**, Springer – Verlag.
Lindholm, R.C. (1987), **A practical Approach to Sedimentology**; Allen & Uniron, London
Krumbein, W.C. and Pettijohn, F.J., **Manual of sedimentary Petrography**, D Appleton – Contury Company, Inc.

Oceanography (Elective)

Robert H. Stewart (2008). **Introduction to Physical Oceanography**. Texas A & M University.
Tom Garrison (2012). **Essentials of Oceanography**, Sixth Edition. Brooks/Cole Publishers, Belmont.
John H. Steele, Steve A. Thorpe and Karl K. Turekian (Eds) (2009**). Elements of Physical Oceanography.** Elsevier, Heidelberg.
Garrison, T.S. (1999). **Essentials of Oceanography**. Wadsworth Publishing Co., California.
Pinet, P.R. (1992). **Oceanography – An Introduction to the Planet Oceanus**. West Publishing Co., Minnesota.
Pipkin, B.W and Trent D.D. (2000). **Geology and the Environment**. Brooks/Cole Publishers, California.

Geochemistry (Elective)

Mason, B. and Moore, C.B., 1991: **Introduction to Geochemistry**-Wiley Eastern
Krauskopf, K.B., 1967**: Introduction to Geochemistry**-McGraw Hill
Faure, G., 1986: **Principles of Isotope Geology**-John Wiley
Hoefs, J., 1980: **Stable isotope Geochemistry** –Springer Verlag
Marshal, C.P. and Fairbridge, R.W., 1999: **Encyclopaedia of Geochemistry**-Kluwer Academic
Govett, G.J.S. (Ed.), 1983: **Handbook of Exploration Geochemistry**-Elsevier
Nordstrorm, D.K. and Munoz, J.L., 1986: **Geochemical Thermodynamics**-Blackwell
Henderson, P., 1987: **Inorganic Geochemistry**-Pergamon Press

SEMESTER – IV
PAPER CODE: MGELEC-2
ADVANCE HYDROGEOLOGY (Elective Paper)

Course Objective:

1. To study the Hydrogeological Maps
2. To determine the hydrological properties of rock.
3. To learn the physical and chemical properties of water.
4. To learn the application of different methods to explore groundwater.

- Study of Hydrogeological maps,
- Study of groundwater conditions in different geological terrains of Bihar.
- Study of hydrological properties of rocks.
- Estimation of pH, conductivity, hardness, chloride, carbonate, bicarbonate, arsenic, calcium and magnesium content in water samples,
- Plotting of groundwater provinces of India,
- Elementary idea of Resistivity meter and AAS
- Graphical presentation of Water quality
- Numericals based on Ground water flow
- Morphometric analysis
- Viva-voce and sessional records.

Course Outcome:

1) Interpret Hydrogeological Map and understand groundwater conditions of the area.
2) Learn the physical and chemical properties of water.
3) Determine the hydrological properties of the rock.
4) Delineate the groundwater provinces of India and groundwater resources of Bihar.

FUEL GEOLOGY (Elective Paper)

Course Objective:

1. To learn the methods of sampling of coal
2. To identify the different types of coal and microfossils.
3. To analysis coal-data problems.
4. To locate different coalfield/oilfields on outline map of India.
5. To study the geological maps and Isopach maps

- Methods of Sampling of coal
- Proximate analysis of coal – data problems
- Structural problems ; completion of outcrop in maps
- Calculation of coal reserves
- Determination of Specific gravity
- Identification of coal samples, interseam rocks, intrusive and microfossils.
- Distribution of various fuel / hydrocarbon resources on outline map of India,
- Study of geological maps, Isopach maps and sections of important oilfields of India,
- Viva-voce and sessional records.

Course Outcome:

1. Methods of Sampling of coal
2. Identify the different types of coal in the field and microfossils under thin sections.
3. Determine the properties of coal .
4. Analyze the Geological and Isopach maps in understanding fuel reserves.
5. Knowledge of coal for industrial purpose.

ADVANCED SEDIMENTOLOGY (Elective Paper)

Course Objective:

1. To identify the different types of sedimentary rocks.
2. To study Textural aspect of sediments and their geological significance.
3. To understand different sedimentary structures and their use.
4. To learn the application of sediemtological data for industrial purpose.

- Size analysis: Graphical representation and determination of different statistical parameters,
- Shape analysis: Determination of roundness and sphericity
- Megascopic and thin section studies of sedimentary rocks,
- Study of different sedimentary structures and their sedimentological significance,
- Thin section studies of heavy minerals,
- Analysis of paleocurrent data
- Viva-voce and sessional record.

Course Outcome:

1. Identify the different kinds of sedimentary rocks in field and under thin sections.

2. A comprehensive idea of Textural significance of sediments.
3. Students shall understand the recognition & significance of heavy minerals.
4. To know the utility of sedimentary structures in understanding paleocurrent direction.
5. Knowledge of sedimentological data for industrial purpose.

GEOCHEMISTRY (Elective Paper)

Course Objective:

1. To analyse geochemical data of Rock / Soil / Sediments / Water .
2. To study & understand the role of isotopes in geochemical analyses.

- Geochemical Analysis of : Rock / Soil / Sediments / Water/ Graphical representation
- Calculation of mineral formulae from concentration of various oxides in minerals.
- Exercise related to Geochemistry and Radiogenic Isotopes
-

Course Outcome:

1. Analyze geochemical data to reveal different earth processes.
2. Knowledge of geochemistry for industrial purpose.

PAPER CODE: MGELEC-2
FIELD TRAINING / DISSERTATION

Course Objective:

1. To Apply Principles of Geology in the field to understand geology of an area.
2. To learn sampling of rocks, collection of field geological data and their presentation.
3. To learn to write a field report.

a Field training designed to acquire special/advanced knowledge, through fieldwork followed by a report preparation which must be submitted before the end of the IVth Semester for evaluation by the Faculty members and the Board of Examiners.

Course Outcome:

1. Understand the application of Principles of Geology in the field to reveal geology of the area.
2. Experience the process of collection of rock samples, toposheet & GPS location and field diary entry of all the relevant field geological data.
3. Framing up of the Field Report based on scientific analysis leading to a professional presentation of the geological data.