

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

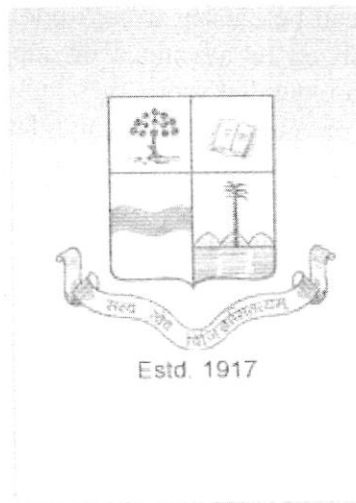
Semester	Course/ Paper Code	Nature of Course/ Paper	Credit	Marks	Marks of CIA	Marks of ESE	Passing criterion	Qualifying Criterion
<b>SEMESTER I</b>	MGELCC-1	Structural Geology and Geotectonics	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MGELCC-2	Mineralogy, Crystallography & Optical Mineralogy	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 & Swachh Bharat Abhiyan	5	100	50	50	45% in CIA 45% in ESE	Qualifying
<b>SEMESTER II</b>	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
	MGELAECC-1 /SEC-1	One Ability Enhancing Elective course (selected from basket)	5	100	50	50	45% in CIA 45% in ESE	Qualifying
<b>SEMESTER III</b>	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
<b>SEMESTER IV</b>	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**

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## **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)  
& Swachhha 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 Swachhha 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
<b>Total</b>		<b>25</b>	<b>170</b>	<b>330</b>	<b>500</b>

### 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
<b>Total</b>		<b>30</b>	<b>200</b>	<b>400</b>	<b>600</b>

### 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
MGELAEC-2	DISCIPLINE SPECIFIC ELECTIVE	5	50	50	100
<b>Total</b>		<b>30</b>	<b>200</b>	<b>400</b>	<b>600</b>

## SEMESTER - IV

Code	COURSES	Credit	Marks of	Marks of	Total
MGELEC-1	<b>ELECTIVE PAPER</b> -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	<b>DSE-1 (Discipline Specific Elective)</b>  <b>GE-1 (Generic Elective)</b> May be unrelated to subject/across	5	30	70	100
<b>Total</b>		<b>15</b>	<b>90</b>	<b>210</b>	<b>300</b>

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,  $2 \times 10 = 20$  marks

**Group B** –Five questions (one from each unit) of 5 marks each, four to be answered,  $5 \times 4 = 20$  marks

**Group C** –Five questions (one from each unit) of 10 marks each, three to be answered  $10 \times 3 = 30$  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,  $2 \times 10 = 20$  marks

**Group B** –Five questions (one from each unit) of 5 marks each, four to be answered,  $5 \times 4 = 20$  marks

**Group C** –Five questions (one from each unit) of 10 marks each, three to be answered  $10 \times 3 = 30$  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, Felspathoids, 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 axis 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 **10×3= 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 equilibria
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.
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**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 **10×3= 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 Photographs & 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