

# PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM-636011



***DEGREE OF BACHELOR OF SCIENCE  
(CHOICE BASED CREDIT SYSTEM)***

**Syllabus for  
B.Sc., GEOLOGY  
SEMESTER PATTERN**

(For Candidates admitted in the Colleges affiliated to Periyar University from 2023-2024 onward)

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# **B.Sc., GEOLOGY**

## **CHOICE BASED CREDIT SYSTEM (CBCS)**

### **REGULATIONS**

#### **I. About the Programme**

Periyar University offers for the affiliated colleges in B.Sc Geology programme, under Choice Based Credit System (CBCS). The CBCS enables the students to select choice of subjects as per her /his interest and requirement. Acquiring knowledge in the related discipline is advantageous to the students. The CBCS programme is framed in such a way that to impart more Knowledge in the field of Geological sciences.

#### **II. Program Educational Objectives (PEOs)**

- PEO1:** To demonstrate an understanding of the fundamental principles, concepts in theoretical and practical knowledge of the geological Science.
- PEO2:** An ability to recognize, evaluate, interpret, and understand issues and opportunities at the frontiers of geological domain.
- PEO3:** Ability to apply the basic knowledge of geology to real-life problems besides the use of computational and mathematical knowledge and tools.
- PEO4:** Work ethically and professionally alone and as part of a team, complying with applicable legislation and managing time and other resources efficiently and effectively and manage, execute their geological plans to meet desired goals realistic constraints.
- PEO5:** Communicate geological information concisely and accurately using written, visual, and verbal means appropriate to the situation.

#### **III. Program Outcomes (POs)**

- PO1:** To develop an in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.
- PO2:** Recognize the need for sustainable use of earth resources, and value environmental, indigenous and other community perspective on geological activities.
- PO3:** Apply geological knowledge and critical thinking skills to identify a problem and to describe a strategy for handling.
- PO4:** Synthesize geological data on arrange of spatial and temporal scales to make interpretations that allow for scientific uncertainty.
- PO5:** Work effectively and professionally in multidisciplinary teams as a member and a leader and be able to manage and analyze complex ethical issues.

#### IV. Program Specific Outcomes (PSOs)

- PSO1:** Learn the essential properties of earth components, including its core, mantle, asthenosphere, lithosphere, cryosphere, hydrosphere, atmosphere and biosphere
- PSO2:** Demonstrate mastery of the conceptual framework for understanding earth system processes and the development of earth's features over time.
- PSO3:** Acquiring geologic data in the field, laboratory, satellites and big data from data banks, Analyzing and interpreting the data through application of scientific method.
- PSO4:** Enable to apply successfully advanced and current concepts and methods of the geosciences to formulate and solve complex geological problems.
- PSO5:** Apply knowledge and techniques from allied fields, including chemistry, physics, biology, mathematics, and computing, to solve geological problems.
- PSO6:** Capable of understanding the impact of a geo-engineering solution in global and societal context.
- PSO7:** Students take-up a geologic problem and utilize theoretical, analytical or experimental approach to solve the problem through their project work. The students will be able to defend their project in an open forum.

| PO/PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
|--------|------|------|------|------|------|------|
| PO1    | ✓    |      |      |      |      |      |
| PO2    |      | ✓    |      |      |      |      |
| PO3    |      |      | ✓    |      |      |      |
| PO4    |      |      |      | ✓    |      |      |
| PO5    |      |      |      |      | ✓    |      |
| PO6    |      |      |      |      |      | ✓    |

#### V. Eligibility for Admission

Candidates for admission to the first year of the Degree of Bachelor of science, Geology course are required to have passed the Higher Secondary Examination (Academic Stream) conducted by the Government of Tamil Nadu or an examination as equivalent to 10 +2 courses including CBSE, which have been recognized by the Periyar University.

The candidates for admission to the Geology shall have passed the qualifying Examination with the subjects under **physics and chemistry as compulsory subjects**.

For admission of students in the Government/Aided/ Unaided Colleges of Arts and Science, guidelines issued by the Director of Collegiate Education, Chennai– 6 may be followed.

#### VI. Duration of the Program

The course for the degree of B.Sc., Geology shall consist of three academic years divided into six semesters. Each Semester consists of 90 working days.

#### VII. Course and study

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

**CURRICULLUM FRAMEWORK**  
**UNDER CHOICE BASED CREDIT SYSTEM (CBCS) B.Sc. Geology**

| Part       | Sub Code | Title of the Paper                                                    | Hrs (wk) | Internal (C/A) Marks | External Marks | Total Marks | Ext- Min. | Total Pass Mark | Credits |
|------------|----------|-----------------------------------------------------------------------|----------|----------------------|----------------|-------------|-----------|-----------------|---------|
|            |          | <b>SEMESTER – 1</b>                                                   |          |                      |                |             |           |                 |         |
| <b>I</b>   |          | <b>Part–I:</b> Language:Tamil I                                       | 6        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>II</b>  |          | <b>Part–II:</b> English I                                             | 6        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>III</b> |          | <b>Core I:</b> General Geology and Crystallography                    | 4        | 25                   | 75             | 100         | 30        | 40              | 5       |
| <b>III</b> |          | <b>Core II:</b> Geo-Statistics                                        | 4        | 25                   | 75             | 100         | 30        | 40              | 5       |
| <b>III</b> |          | <b>Allied - 1:</b> Allied Mathematics 1/ Allied Chemistry – I         | 4        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>III</b> |          | Allied Chemistry Practical – I                                        | 2        | 40                   | 60             | 100         | 24        | 40              | 2       |
| <b>IV</b>  |          | Skill Enhancement Course SEC-1 (NME)                                  | 2        | 25                   | 75             | 100         | 30        | 40              | 2       |
| <b>IV</b>  |          | Foundation Course-FC: Understanding the earth                         | 2        | 25                   | 75             | 100         | 30        | 40              | 2       |
|            | Total    |                                                                       | 30       |                      |                |             |           |                 | 25      |
|            |          | <b>SEMESTER – 2</b>                                                   |          |                      |                |             |           |                 |         |
| <b>I</b>   |          | <b>Part–I:</b> Language: Tamil-II                                     | 6        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>II</b>  |          | <b>Part–II:</b> English- II                                           | 4        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>IV</b>  | NMSDC    | Overview of English Language Communication                            | 2        | 25                   | 75             | 100         | -         | -               | 2       |
| <b>III</b> |          | <b>Core-3:</b> Palaeontology                                          | 5        | 25                   | 75             | 100         | 30        | 40              | 5       |
| <b>III</b> |          | <b>Core Practical I :</b> Crystallography and Palaeontology Practical | 3        | 40                   | 60             | 100         | 30        | 40              | 3       |
| <b>III</b> |          | <b>Allied -2 :</b> Allied Chemistry II/ Allied Mathematics –II        | 4        | 25                   | 75             | 100         | 30        | 40              | 3       |
| <b>III</b> |          | Allied Chemistry Practical – II                                       | 2        | 40                   | 60             | 100         | 24        | 40              | 2       |
| <b>IV</b>  |          | Skill Enhancement Course -SEC-2 (NME)                                 | 2        | 25                   | 75             | 100         | 30        | 40              | 2       |
| <b>IV</b>  |          | Skill Enhancement Course -SEC-3: Basics of Earth Science              | 2        | 25                   | 75             | 100         | 30        | 40              | 2       |
| <b>IV</b>  |          | Disaster Management                                                   | 2        | 25                   | 75             | 100         | -         | -               | 1       |
|            | Total    |                                                                       | 30       |                      |                |             |           |                 | 26      |

| Part       | Sub Code    | Title of the Paper                                                              | Hrs (wk) | Internal (CA) Marks | External Marks | Total Marks | Ext- Min. | Total Pass Mark | Credits  |
|------------|-------------|---------------------------------------------------------------------------------|----------|---------------------|----------------|-------------|-----------|-----------------|----------|
|            |             | <b>SEMESTER – 3</b>                                                             |          |                     |                |             |           |                 |          |
| <b>I</b>   |             | <b>Part-I:</b> Language: Tamil III                                              | 6        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>II</b>  |             | <b>Part-II:</b> English III                                                     | 6        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>III</b> |             | <b>Core : 4 :</b> Mining Geology                                                | 4        | 25                  | 75             | 100         | 30        | 40              | 5        |
| <b>III</b> |             | <b>Core : 5</b> Geomorphology and Geotectonics                                  | 4        | 25                  | 75             | 100         | 30        | 40              | 5        |
| <b>III</b> |             | <b>Allied-3:</b> Allied Physics –I                                              | 4        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>III</b> |             | Allied Physics Practical–I                                                      | 2        | 40                  | 60             | 100         | 24        | 40              | 2        |
| <b>IV</b>  |             | Skill Enhancement Course -SEC-4 Entrepreneurial Based-Principles of surveying.  | 1        | 25                  | 75             | 100         | 30        | 40              | 1        |
| <b>IV</b>  | <b>SDTC</b> | <b>Digital Skills for Employability</b>                                         | <b>2</b> | <b>25</b>           | <b>75</b>      | <b>100</b>  | <b>30</b> | <b>40</b>       | <b>2</b> |
| <b>IV</b>  |             | E.V.S                                                                           | 1        | -                   | -              | -           | -         | -               | -        |
|            |             | Health and Wellness                                                             |          |                     |                |             |           |                 | 1        |
|            | Total       |                                                                                 | 30       |                     |                |             |           |                 | 25       |
|            |             | <b>SEMESTER – 4</b>                                                             |          |                     |                |             |           |                 |          |
| <b>I</b>   |             | <b>Part-I:</b> Language: Tamil IV                                               | 6        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>II</b>  |             | <b>Part-II:</b> English IV                                                      | 6        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>III</b> |             | <b>Core 6:</b> Structural Geology&Photogeology                                  | 5        | 25                  | 75             | 100         | 30        | 40              | 5        |
| <b>III</b> |             | <b>Core Practical II :</b> Structural Geology, Remote Sensing, Survey Practical | 3        | 40                  | 60             | 100         | 30        | 40              | 3        |
| <b>III</b> |             | <b>Allied - 4 :</b> Allied Physics- II                                          | 3        | 25                  | 75             | 100         | 30        | 40              | 3        |
| <b>III</b> |             | Allied Physics Practical–II                                                     | 2        | 40                  | 60             | 100         | 24        | 40              | 2        |

| IV   |          | Skill Enhancement Course -SEC-6: Field Hydrogeology and Techniques   | 2        | 25                  | 75             | 100         | 30        | 40              | 2       |
|------|----------|----------------------------------------------------------------------|----------|---------------------|----------------|-------------|-----------|-----------------|---------|
| IV   | NMSDC    | Digital Skills for Employability                                     | 2        | 25                  | 75             | 100         |           |                 | 2       |
| Part | Sub Code | Title of the Paper                                                   | Hrs (wk) | Internal (CA) Marks | External Marks | Total Marks | Ext- Min. | Total Pass Mark | Credits |
| IV   | NMSDC    | Graphic design                                                       | 2        | 25                  | 75             | 100         | 30        | 40              | 2       |
| IV   |          | E.V.S                                                                | 1        | 25                  | 75             | 100         | 30        | 40              | 2       |
|      | Total    |                                                                      | 30       |                     |                |             |           |                 | 25      |
|      |          | <b>SEMESTER – 5</b>                                                  |          |                     |                |             |           |                 |         |
| III  |          | <b>Core 7 : Stratigraphy</b>                                         | 6        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core 8 : Mineralogy</b>                                           | 6        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core 9 : Igneous Petrology</b>                                    | 5        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core 10 :Sedimentary and Metamorphic Petrology</b>                | 5        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Elective-5 Hydrogeology</b>                                       | 4        | 25                  | 75             | 100         | 30        | 40              | 4       |
|      |          | <b>Elective -6 Remotesensing &amp;GIS</b>                            | 4        | 25                  | 75             | 100         | 30        | 40              | 3       |
| IV   |          | Value Education                                                      | 2        | 25                  | 75             | 100         | 30        | 40              | 2       |
| IV   |          | Internship / Industrial Visit / Field Visit                          |          |                     |                |             |           |                 |         |
| IV   | SDTC     | Creative Skills for Employability                                    | 2        | 25                  | 75             | 100         |           |                 | 2       |
|      | Total    |                                                                      | 30       |                     |                |             |           |                 | 24      |
|      |          | <b>SEMESTER – 6</b>                                                  |          |                     |                |             |           |                 |         |
| III  |          | <b>Core 11 : Regional Geology</b>                                    | 6        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core 12 : Economic Geology and Mineral Economics</b>              | 6        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core 13 Applied Geology</b>                                       | 6        | 25                  | 75             | 100         | 30        | 40              | 4       |
| III  |          | <b>Core Practical III Mineralogy and Petrology practical</b>         | 5        | 40                  | 60             | 100         | 30        | 40              | 2       |
| III  |          | <b>Core Practical IV Economic geology and Ore analysis practical</b> | 5        | 40                  | 60             | 100         | 30        | 40              | 2       |

|             |                 |                                                  |                 |                            |                       |                    |                  |                        |                |
|-------------|-----------------|--------------------------------------------------|-----------------|----------------------------|-----------------------|--------------------|------------------|------------------------|----------------|
| <b>IV</b>   |                 | Extension Activity                               | -               |                            |                       |                    |                  |                        | 1              |
| <b>Part</b> | <b>Sub Code</b> | <b>Title of the Paper</b>                        | <b>Hrs (wk)</b> | <b>Internal (CA) Marks</b> | <b>External Marks</b> | <b>Total Marks</b> | <b>Ext- Min.</b> | <b>Total Pass Mark</b> | <b>Credits</b> |
| <b>IV</b>   |                 | Professional Competency Skill                    | 2               | 25                         | 75                    | 100                | 30               | 40                     | 2              |
| <b>IV</b>   | NMSDC           | Creative and Innovative Skills for Employability | 2               | 25                         | 75                    | 100                |                  |                        | 2              |
|             |                 | Total                                            | 30              |                            |                       |                    |                  |                        | 19             |
|             | Overall         | <b>Total/Credits</b>                             |                 |                            |                       |                    |                  |                        | <b>144</b>     |

### COMPULSORY COURSES

1. Value Education
2. Environmental Studies
3. Extension Activities (NSS, NCC, YRC, RRC, Green Club)

### VIII. Distribution of Marks

|           |          |      |       |
|-----------|----------|------|-------|
|           | Internal | Exam | Total |
| Theory    | 25       | 75   | 100   |
| Practical | 40       | 60   | 100   |

#### Core practical marks 40 further divided as follows:-

|                                  |   |          |
|----------------------------------|---|----------|
| Field visit, Collections, Report | - | 10       |
| Practical records                | - | 10       |
| Attendance                       | - | 05       |
| Test                             | - | 15       |
|                                  |   | <hr/> 40 |

#### Classification of Internal Assessment for Theory:

|            |   |          |
|------------|---|----------|
| Test       | - | 15       |
| Assignment | - | 05       |
| Attendance | - | 05       |
| Total      |   | <hr/> 25 |

## IX. Question Paper Pattern

Time: 3h.

Maximum marks: 75

**Part –A (15 x 1 = 15)** Answer all questions

Each unit carry 3 multiple choice question

**Part – B (2 x 5 = 10)** Answer any 2 questions (out of five)

one question should be in each unit

**Part –C (5 x 10 = 50)** Answer all questions(either or type)

one question should be in each unit

## X) Field Work/Training

Geological field mapping is included in the first year, second year and third year. Its participation is a mandatory requirement. The training is to be scheduled for duration of maximum 15 days. It may be guided by faculty members in any place which is geologically significant region within Tamil Nadu and India. .

## XI) Subject Name with Subject code

| Sl.No                     | Subject Name                                              | Subject Code | Semester |
|---------------------------|-----------------------------------------------------------|--------------|----------|
| 01                        | General Geology and Crystallography                       | 23UGECT01    | I        |
| 02                        | Geo-statistics                                            | 23UGECT02    | I        |
| 03                        | Foundation course- Understanding the Earth                |              | I        |
| 04                        | Crystallography and Paleontology Practical-1              | 23UGECP01    | II       |
| 05                        | Paleontology                                              | 23UGECT03    | II       |
| 06                        | SEC-3 Basics of Earth Science                             | 23UGESO01    | II       |
| 07                        | Mining Geology                                            | 23UGECT04    | III      |
| 08                        | Geomorphology and Geotectonics                            | 23UGECT05    | III      |
| 09                        | SEC-4 Principles of surveying (Entrepreneurship)          | 23UGESO02    | III      |
| 10                        | SEC-5 GeoHazards                                          | 23UGESO03    | III      |
| 11                        | Structural geology and photo geology                      | 23UGECT06    | IV       |
| 12                        | Structural Geology, Remote Sensing and Survey Practical-2 | 23UGECP02    | IV       |
| 13                        | SEC-6 Field hydrogeology & Techniques                     | 23UGESO04    | IV       |
| 14                        | SEC-7 Geo-heritage and Geo-tourism                        | 23UGESO05    | IV       |
| 15                        | Stratigraphy                                              | 23UGECT07    | V        |
| 16                        | Mineralogy                                                | 23UGECT08    | V        |
| 17                        | Igneous Petrology                                         | 23UGECT09    | V        |
| 18                        | Sedimentary and Metamorphic Petrology                     | 23UGECT10    | V        |
| 19                        | Elective-V Hydrogeology                                   | 23UGEEM01    | V        |
| 20                        | Elective-VI Remote Sensing & GIS                          | 23UGEEM02    | V        |
| 21                        | Regional Geology                                          | 23UGECT11    | VI       |
| 22                        | Economic Geology and Mineral Economics                    | 23UGECT12    | VI       |
| 23                        | Applied Geology                                           | 23UGECT13    | VI       |
| 24                        | Mineralogy and Petrology Practical-3                      | 23UGECP03    | VI       |
| 25                        | Economic Geology and Ore analysis Practical-4             | 23UGECP04    | VI       |
| NON MAJOR ELECTIVE COURSE |                                                           |              |          |
| 1                         | Gemology and Gemstone Evolution                           | 23UGENM01    |          |

|   |              |           |  |
|---|--------------|-----------|--|
| 2 | Oceanography | 23UGENM02 |  |
|---|--------------|-----------|--|

***XII-Credit Distribution for THEORY with LAB Hours***

**First Year**

**Semester-I**

| Part    | List of Courses                           | Credit | No. of Hours |
|---------|-------------------------------------------|--------|--------------|
| Part-1  | Language-Tamil                            | 3      | 6            |
| Part -2 | English                                   | 3      | 6            |
| Part-3  | Core: General Geology and Crystallography | 5      | 5            |
|         | Geo-statistics                            | 5      | 5            |
|         | Allied Mathematics 1/Allied Chemistry 1   | 3      | 4            |
| Part-4  | Skill Enhancement Course SEC-1 (NME)      | 2      | 2            |
|         | Foundation Course-Understanding the Earth | 2      | 2            |
|         |                                           | 23     | 30           |

**Semester-II**

| Part   | List of Courses                                         | Credit | No. of Hours |
|--------|---------------------------------------------------------|--------|--------------|
| Part-1 | Language- Tamil                                         | 3      | 6            |
| Part-2 | English                                                 | 3      | 6            |
| Part-3 | Core: Crystallography & Paleontology Practical          | 5      | 5            |
|        | Core: Palaeontology                                     | 5      | 5            |
|        | Allied Mathematics II/ Allied Chemistry II              | 3      | 4            |
| Part-4 | Skill Enhancement Course -SEC-2 (NME)                   | 2      | 2            |
|        | Skill Enhancement Course -SEC-3 Basics of Earth Science | 2      | 2            |
|        |                                                         | 23     | 30           |

## Second Year

### Semester-III

| Part   | List of Courses                                                                 | Credit | No. of Hours |
|--------|---------------------------------------------------------------------------------|--------|--------------|
| Part-1 | Language                                                                        | 3      | 6            |
| Part-2 | English                                                                         | 3      | 6            |
| Part-3 | Core: Mining Geology                                                            | 5      | 5            |
|        | Core: Geomorphology and Geotectonics                                            | 5      | 5            |
|        | Allied Physics – I                                                              | 3      | 4            |
| Part-4 | Skill Enhancement Course -SEC-4-Principles of surveying (Entrepreneurial Based) | 1      | 1            |
|        | Skill Enhancement Course -SEC-5- Geo Hazards                                    | 2      | 2            |
|        | E.V.S                                                                           | -      | 1            |
|        |                                                                                 | 22     | 30           |

### Semester-IV

| Part   | List of Courses                                                | Credit | No. of Hours |
|--------|----------------------------------------------------------------|--------|--------------|
| Part-1 | Language- Tamil                                                | 3      | 6            |
| Part-2 | English                                                        | 3      | 6            |
| Part-3 | Core: Structural Geology and Photo Geology                     | 5      | 5            |
|        | Core: Structural Geology, Remote Sensing and Survey Practical  | 5      | 5            |
|        | Allied Physics – II                                            | 3      | 3            |
| Part-4 | Skill Enhancement Course -SEC-6-Field Hydrogeology &Techniques | 2      | 2            |
|        | Skill Enhancement Course -SEC-7Geo-Heritage and Geo-Tourism    | 2      | 2            |
|        | E.V.S                                                          | 2      | 1            |
|        |                                                                | 25     | 30           |

Third Year

**Semester-V**

| Part   | List of Courses                             | Credit | No. of Hours |
|--------|---------------------------------------------|--------|--------------|
| Part-3 | Stratigraphy                                | 4      | 5            |
|        | Mineralogy                                  | 4      | 5            |
|        | Igneous Petrology                           | 4      | 5            |
|        | Sedimentary and Metamorphic Petrology       | 4      | 5            |
|        | Elective-V Hydrogeology                     | 3      | 4            |
|        | Elective – VI Remote Sensing                | 3      | 4            |
| Part-4 | Value Education                             | 2      | 2            |
|        | Internship / Industrial Visit / Field Visit | 2      | -            |
|        |                                             | 26     | 30           |

**Semester-VI**

| Part   | List of Courses                             | Credit | No. of Hours |
|--------|---------------------------------------------|--------|--------------|
| Part-3 | Regional Geology                            | 4      | 6            |
|        | Economic Geology and Mineral Economics      | 4      | 6            |
|        | Applied Geology                             | 4      | 6            |
|        | Mineralogy and petrology practical          | 3      | 5            |
|        | Economic geology and ore analysis practical | 3      | 5            |
| Part-4 | Extension Activity                          | 1      | -            |
|        | Professional Competency Skill               | 2      | 2            |
|        |                                             | 21     | 30           |
|        | <b>Total Credits – 140</b>                  |        |              |

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT01         | GENERAL GEOLOGY AND CRYSTALLOGRAPHY                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Core     | Y | - | - | - | 5       | 4            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |   |   |   |   |         |              |                   |          |       |
| CO1               | The main objective of this course is to enumerate the origin of Earth.                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To describe the concepts of Dating and internal structure of the Earth                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO3               | To explain various components of crystals and crystallography                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO4               | To study various class and forms of an crystal system.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To determine various crystallographic properties of crystals with suitable examples.                                                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Universe – Evolution of the Universe – Stellar system – Milky Way Galaxy –Evolution of Galaxy. Solar System – Inner and outer planets – characteristics of solar system. Satellites – Asteroids – Meteors – comets. Earth – movements – revolution – rotation – solstice – equinox – time – GMT – IST. Atmosphere – Monsoon- El Nino – hydrosphere – lithosphere- Origin of the Earth – Nebular and Planetesimal hypothesis – Tidal & Vonweizacker's hypothesis – merits and demerits of the above hypotheses |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Age of the Earth – old methods – new methods – Radioactivity – Half-life period – Radiometric methods – Uranium / Lead method – Rubidium / Strontium method – Lead / Lead method – Potassium/Argon - Carbon 14 method. Numerical methods in dating. Interior of the Earth – Density – Shape – Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity – Weichert-Guttenberg Discontinuity                                  |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Definition of crystal – Unit cell, Bravais Lattices, Plane groups, Point groups & Space groups - Crystallographic axes – Symmetry Elements – Division of crystals into systems and Point groups – Axial Ratio – Parameters – Indices – Miller Indices – Symbol – Hermann Mauguin                                                                                                                                                                                                                              |          |   |   |   |   |         | 12           | CO3               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | notations -Law of Rational Indices - Forms - simple - combination - open - closed - unit - holohedral - hemihedral - tetrahedral - hemimorphic - enantiomorphous forms - Interfacial angle and its measurement with Contact Goniometer. Types of Goniometers                                                                                                                                                                                      |          |     |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Study of common forms and combinations of the following systems and classes: Isometric System: Hexoctahedral, Diploidal, Hextetrahedral - Tetragonal System: Ditetragonalbipyramidal, Tetragonal bipyramidal, Tetragonal Pyramidal, Tetragonal Sphenoidal - Hexagonal System: DihexagonalBipyramidal, Hexagonal BipyramidalTrigonal System - DitrigonalScalenohedral - Ditrigonal pyramidal, Trirhombohedral, Trigonaltrapezohedral.              | 12       | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Study of common forms and combinations of the following systems and classes: Orthorhombic System: Rhombic Bipyramidal, Rhombic pyramidal, RhombicDisphenoidal - Monoclinic System: Prismatic - Triclinic System: Pinacoidal - Twinning in crystals - laws of twinning - types: contact, interpenetration, polysynthetic, repeated - important examples from six systems - Irregularities of crystals-An introduction to stereographic projection. | 12       | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total                                                                                                                                                                                                                                                                                                                                                                                                                                             | 60       |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | On completion of this course, students will;                                                                                                                                                                                                                                                                                                                                                                                                      |          |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the origin of Galaxy, Our Solar System and Crystal Science                                                                                                                                                                                                                                                                                                                                                                             | PO1      |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Knowledge on Dating of Earth Age                                                                                                                                                                                                                                                                                                                                                                                                                  | PO1, PO2 |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Correlate various Hypothesis on Origin of Earth                                                                                                                                                                                                                                                                                                                                                                                                   | PO4, PO6 |     |

|                                                                                                 |                                                                                                                                                             |               |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| C04                                                                                             | Analyze the importance of Crystallography Studies                                                                                                           | PO4, PO5, PO6 |
| C05                                                                                             | Various Type minerals and their respective crystal system                                                                                                   | PO3, PO8      |
| Text Books<br>(Latest Editions)                                                                 |                                                                                                                                                             |               |
| 1.                                                                                              | Mineralogy – Dexter Perkins (2014), 3rd edition, Pearson New International Edition.                                                                         |               |
| 2.                                                                                              | Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.                                                       |               |
| 3.                                                                                              | Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)                                                                                        |               |
| 4.                                                                                              | Mukherjee A.K, Principles of Geology, EW Press, Kolkata(1990)                                                                                               |               |
| 5.                                                                                              | Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005                                                                               |               |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                             |               |
| 1.                                                                                              | Introduction to Mineralogy – William D. Nesse (2000), Oxford University press, New York. USA.                                                               |               |
| 2.                                                                                              | Textbook of Mineralogy – E.S. Dana, (2000), 3rd edition, CBS Publishers & Distributers, New Delhi.                                                          |               |
| 3.                                                                                              | Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.                                                                   |               |
| 4.                                                                                              | Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer                                                     |               |
| 5.                                                                                              | Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)                                                                                      |               |
| Web Resources                                                                                   |                                                                                                                                                             |               |
| 1.                                                                                              | "Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005. Retrieved 2006-01-10.                                     |               |
| 2.                                                                                              | Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London. |               |
| 3.                                                                                              | Geo.libretexts.org                                                                                                                                          |               |
| 4.                                                                                              | <a href="#">_____</a>                                                                                                                                       |               |
| 5.                                                                                              | Solarsysytem.nasa.gov                                                                                                                                       |               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                 | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                              |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT02         | GEO-STATISTICS                                                                                                                                                                                                               | Core     | Y | - | - | - | 5       | 4            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO1               | The main objective of this course is to importance of statistics in science.                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To describe the concepts of basic statistics                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO3               | To explain various components of advanced statistical methods                                                                                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO4               | To study various graphical methods and its applications                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To determine various correlation and regression studies and its importance in the field of Geology                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                      |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Definition and scope of statistics-Tabulation of data-Formation of Frequency Distribution-Diagrammatic representation of data-Bar diagrams, Pie diagrams-Graphic Representation of data-Histogram, Frequency polygon-Ogives. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Measures of Central Tendency-Arithmetic Mean Median, Mode, Combined arithmetic mean-merits and demerits.                                                                                                                     |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Measures of Dispersion- Absolute and Relative measures Range, Quartile deviation, Mean deviation, Standard deviation                                                                                                         |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Cure filling by the Method of Least square-Fitting                                                                                                                                                                           |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |               |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | straight line of the form $Y=ax+b$ and parabola $Y= a x^2 + b x +c$ (Simple problems)                                                                                                               |               |     |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Correlation-Karl person's coefficient of correlation, Rank correlation- Spearman's Rank correlation coefficient.<br>Reregression-regression equation and their properties.                          | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                               | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                                     |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                                                                                        |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To describe the definition, scope, classification, tabulation, drawing diagrams and plotting graphs of Statistics through Geological information.                                                   | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To measure and interpret the various measures of averages using Geological data.                                                                                                                    | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To measure and interpret the various measures of dispersions using Geological data.                                                                                                                 | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To measure and interpret the relationship among the geological variables and to estimate and predict the unknown and future value through the regression lines using geological data.               | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To fit the curve using geological data.                                                                                                                                                             | PO3, PO8      |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Statistics – R.S.N. Pillai and V. Bhagavathi, Publicationss. Chand.                                                                                                                                 |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Statistical Methods, Gupta, S.P. (2007): sultan Chand &sons Pvt Ltd, New Delhi, s5 <sup>th</sup> Revised Edition.                                                                                   |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Statistics for Geoscientists - Marsal, D. Pergamon press, New York.                                                                                                                                 |               |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Cline, Graysen (2019). <a href="#">Nonparametric Statistical Methods Using R</a> . EDTECH. ISBN 978-1-83947-325-8. OCLC 1132348139. Archived from the original on 2022-05-15. Retrieved 2021-09-16. |               |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) Introduction to Statistics: Concepts and Applications, pp. 5–9. West Group. <a href="#">ISBN 978-0-314-03309-3</a>                             |               |     |
| References Books                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                     |               |     |

|                                                                             |                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                                                                     |
| 1.                                                                          | Statistics for Geoscientists - Marsal, D. Pergamon press, New York.                                                                                                                                 |
| 2.                                                                          | Statistics – R.S.N. Pillai and V. Bhagavathi, Publications. Chand.                                                                                                                                  |
| 3.                                                                          | Statistical Methods, Gupta, S.P. (2007): sultan Chand &sons Pvt Ltd, New Delhi, 5 <sup>th</sup> Revised Edition.                                                                                    |
| 4.                                                                          | Cline, Graysen (2019). <a href="#">Nonparametric Statistical Methods Using R</a> . EDTECH. ISBN 978-1-83947-325-8. OCLC 1132348139. Archived from the original on 2022-05-15. Retrieved 2021-09-16. |
| 5.                                                                          | Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) Introduction to Statistics: Concepts and Applications, pp. 5–9. West Group. ISBN 978-0-314-03309-3                                             |
| Web Resources                                                               |                                                                                                                                                                                                     |
| 1.                                                                          | <a href="https://en.wikipedia.org/wiki/Statistics">https://en.wikipedia.org/wiki/Statistics</a>                                                                                                     |
| 2.                                                                          | <a href="http://onlinestatbook.com/2/introduction/descriptive.html">http://onlinestatbook.com/2/introduction/descriptive.html</a>                                                                   |
| 3.                                                                          | <a href="https://socialresearchmethods.net/kb/statdesc.php">https://socialresearchmethods.net/kb/statdesc.php</a>                                                                                   |
| 4.                                                                          | <a href="https://en.wikipedia.org/wiki/Descriptive_statistics">https://en.wikipedia.org/wiki/Descriptive_statistics</a>                                                                             |
| 5.                                                                          | <a href="#">Philosophy of Statistics</a> fromtheStanford Encyclopedia of Philosophy                                                                                                                 |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3) M-Medium (2)L-Low (1)

Part-IV\_ FOUNDATION COURSE

| Subject Code                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Subject Name                                                                                                                                                                                                                                                                                                                                      | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | UNDERSTANDING THE EARTH                                                                                                                                                                                                                                                                                                                           | F<br>C   | Y | - | - | - | 2       | 2            | 25                | 75       | 100   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The main objective of this course is to understand various properties of Earth.                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To describe the concepts of internal structure of the Earth                                                                                                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To explain various components related to external processes of Earth                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To study concepts of various currents and atmospheric circulation.                                                                                                                                                                                                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To understand the availability of elements in the Earth.                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| UNIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Details                                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Understanding of planet Earth: Astronomy, Geology, Meteorology and Oceanography. General characteristics and origin of the Universe, Solar System and its planets. The terrestrial and jovian planets. Meteorites and Asteroids Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters and its age. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Internal structure: core, mantle, crust; External Structure: hydrosphere, atmosphere and biosphere. Earth's magnetic field.                                                                                                                                                                                                                       |          |   |   |   |   |         | 12           | CO2               |          |       |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Plate tectonics, sea-floor spreading and continental drift; Mid Oceanic Ridges, trenches, transform faults and island arcs Origin of oceans, continents, mountains and rift valleys Earthquake and Volcanoes.                                                                                                                                     |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Concepts of eustasy; Land-air-sea interaction Oceanic current system and effect of Coriolis force; Wave erosion and beach processes Atmospheric circulation; Weather and climatic changes.                                                                                                                                                        |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Distribution of elements in solar system and in Earth; Chemical differentiation and composition of the Earth; General concepts about geochemical cycles and mass balance<br>Properties of elements; Geochemical behavior of major elements; Mass conservation of elements and isotopic fractionation.                                             |          |   |   |   |   |         | 12           | CO5               |          |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Total                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |         | 60           |                   |          |       |
| The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. The blooms taxonomy verbs will be given as a separate annexure for your reference. Each course outcome should be mapped with the POs. The mapping of each CO can be done with any number of POs. |                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| Course Outcom                                                                                                                                                                                                                                                                                                                                                                                                                                                            | On completion of this course, students will;                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |

| es                                                                                                      |                                                                                                                                                                    |               |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1                                                                                                     | Understand the properties of Earth                                                                                                                                 | PO1           |
| CO2                                                                                                     | Knowledge on Dating of Earth Age                                                                                                                                   | PO1, PO2      |
| CO3                                                                                                     | Correlate various Hypothesis on Origin of Earth                                                                                                                    | PO4, PO6      |
| CO4                                                                                                     | Analyze the importance of Crystallography Studies                                                                                                                  | PO4, PO5, PO6 |
| CO5                                                                                                     | Various Type minerals and their respective crystal system                                                                                                          | PO3, PO8      |
| <b>Text Books<br/>(Latest Editions)</b>                                                                 |                                                                                                                                                                    |               |
| 1.                                                                                                      | Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.                                                               |               |
| 2.                                                                                                      | Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment.Cambridge University Press.                                       |               |
| 3.                                                                                                      | Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)                                                                                               |               |
| 4.                                                                                                      | Mukherjee A.K, Principles of Geology, EW Press, Kolkata(1990)                                                                                                      |               |
| 5.                                                                                                      | Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005                                                                                      |               |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b> |                                                                                                                                                                    |               |
| 1.                                                                                                      | Gross, M. G. (1977). Oceanography: A view of the earth.                                                                                                            |               |
| 2.                                                                                                      | Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.                                                              |               |
| 3.                                                                                                      | Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.                                                                          |               |
| 4.                                                                                                      | Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer                                                            |               |
| 5.                                                                                                      | Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)                                                                                             |               |
| <b>Web Resources</b>                                                                                    |                                                                                                                                                                    |               |
| 1.                                                                                                      | <i>"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005. Retrieved 2006-01-10.</i>                                     |               |
| 2.                                                                                                      | <i>Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.</i> |               |
| 3.                                                                                                      | Geo.libretexts.org                                                                                                                                                 |               |
| 4.                                                                                                      | www.nationalgeographic.org                                                                                                                                         |               |
| 5.                                                                                                      | Solarsysytem.nasa.gov                                                                                                                                              |               |

**In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.**

**The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.**

- **Remember and Understanding – Lower level**

- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

**Mapping with Programme Outcomes:**

|             | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO 1</b> | 3           | 3           | 2           | 3           | 3           | 3           | 2           | 2           |
| <b>CO 2</b> | 2           | 3           | 3           | 3           | 3           | 3           | 3           | 3           |
| <b>CO 3</b> | 3           | 3           | 3           | 3           | 3           | 3           | 2           | 1           |
| <b>CO 4</b> | 3           | 3           | 3           | 3           | 3           | 2           | 1           | 1           |
| <b>CO 5</b> | 3           | 3           | 3           | 3           | 2           | 2           | 2           | 3           |

**S-Strong(3)    M-Medium (2)    L-Low (1)**

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGCEP01         | CRYSTALLOGRAPHY AND PALOENTOLOGY PRACTICAL                                                                                                                                                                                                                                                                                                                                                                                                                      | Core     | Y | - | - | - | 3       | 2            | 40                | 60       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO1               | The main objective of this course is to enumerate the origin of Earth.                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To describe the concepts of Dating and internal structure of the Earth                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO3               | To explain various components of crystals and crystallography                                                                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO4               | To study various class and forms of an crystal system.                                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To determine various crystallographic properties of crystals with suitable examples.                                                                                                                                                                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Isometric System: Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper- Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite. Tetragonal System: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, MeioniteSphenidal Class – Chalcopyrite. Hexagonal System: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz. |          |   |   |   |   |         | 12           | CO1               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Orthorhombic System: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite.<br>Monoclinic System: Normal – Gypsum, Pyroxenes and Amphiboles.<br>Triclinic System: Normal – Axinite, Albite, and Rhodonite.<br>Twin Crystals: Contact and Penetration twins of Fluorite, Iron Cross Twin of Pyrite, Knee type twin of Cassiterite, Polysynthetic twin of Aragonite, Cyclic twin of Cerussite, Swallow Tail of Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite. | 12  | CO2 |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Identification and description of the following fossils:<br>Lamellibranchs: Arca, Meretrix, Pecten, Cardita, Lima, Allectronia, Inoceramus, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Trigonia. Gastropods: Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cypraea.                                                                                                                                                                                                                                             | 12  | CO3 |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Cephalopods: Nautilus, Orthoceras, Ceratite, Goniatite, Belemnites, Baculites, and Perisphinctes. Echinodermata: Cidaris, Holaster, Hemiaster, Stigmatophygus, Apiocrinus. Trilobites: Paradoxides, Olenus, Olenellus, Phacops, Calymene.                                                                                                                                                                                                                                                                                                           | 12  | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Corals: Calceola, Zaphrentis, Lithostrotion, Omphyma, Thecosmelia. Brachiopoda: Terebratula, Spirifer, Productus, Monograptus, Tetragraptus, Diplograptus.                                                                                                                                                                                                                                                                                                                                                                                          | 12  | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 60  |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | On completion of this course, students will;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The main objective of this course is to enumerate the fundamental aspects of Mineralogy in such a way as to stimulate the minds of the post-graduate students.                                                                                                                                                                                                                                                                                                                                                                                      | PO1 |     |

|                                                                                                 |                                                                                                                                                                                                                                         |               |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| C02                                                                                             | To describe the concepts of Mineralogy is essential to comprehend the concepts of Petrology.                                                                                                                                            | PO1, PO2      |
| C03                                                                                             | To explain the importance of instrumentation techniques for better analysis                                                                                                                                                             | PO4, PO6      |
| C04                                                                                             | To compare and contrast between the fascinating plethora of colorful minerals and crystals, this discipline requires good knowledge of Chemistry, and poses several intriguing questions, leading to sustained interest in this subject | PO4, PO5, PO6 |
| C05                                                                                             | Can evaluate the accuracy and summaries the methods adapted for certain practical activities.                                                                                                                                           | PO3, PO8      |
| Text Books<br>(Latest Editions)                                                                 |                                                                                                                                                                                                                                         |               |
| 1.                                                                                              | Mineralogy – Dexter Perkins (2014), 3rd edition, Pearson New International Edition.                                                                                                                                                     |               |
| 2.                                                                                              | Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.                                                                                                                                   |               |
| 3.                                                                                              | Agashe, S.N, Paleo botany, Oxford & IBH. Delhi(1995)                                                                                                                                                                                    |               |
| 4.                                                                                              | Stewart W.N. & G.W. Rothwell, Palaeobotany, Cambridge University Press. D 2005)                                                                                                                                                         |               |
| 5.                                                                                              | Moore R.C. et al., Invertebrate Fossils. CBS. Delhi (1952).                                                                                                                                                                             |               |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                                                                                                         |               |
| 1.                                                                                              | Introduction to Mineralogy – William D. Nesse (2000), Oxford University press, New York. USA.                                                                                                                                           |               |
| 2.                                                                                              | Textbook of Mineralogy – E.S. Dana, (2000), 3rd edition, CBS Publishers & Distributors, New Delhi.                                                                                                                                      |               |
| 3.                                                                                              | Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.                                                                                                                                               |               |
| 4.                                                                                              | Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer                                                                                                                                 |               |
| 5.                                                                                              | Colbert E.H. et al., Evolution of the Vertebrates, Wiley. New Delhi 2002)                                                                                                                                                               |               |
| Web Resources                                                                                   |                                                                                                                                                                                                                                         |               |
| 1.                                                                                              | "Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005. Retrieved 2006-01-10.                                                                                                                 |               |
| 2.                                                                                              | Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.                                                                             |               |
| 3.                                                                                              | Digitalatlas.cose.ISU.edu>geo>basics>fossil                                                                                                                                                                                             |               |
| 4.                                                                                              | <a href="http://www.sciencedirect.com&gt;topic&gt;hemichordata">www.sciencedirect.com&gt;topic&gt;hemichordata</a>                                                                                                                      |               |
| 5.                                                                                              | w.qm.qid.au>biodiscovery>corals                                                                                                                                                                                                         |               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                      | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                   |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT03         | PALAEONTOLOGY                                                                                                                                                     | Core     | Y | - | - | - | 5       | 5            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics of Fossils                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Understand the importance of fossils in Geological studies                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know different phylum and their species with morphological changes                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand and correlate fossil with various rock formations                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Understand the importance of Palaeontology in dating and evolution studies                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                           |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Fossils –Definition-conditions required for fossilization- Modes of preservation-Uses of fossils. Geological time scale.                                          |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | The morphology and geological distribution of Mollusca- classes, Pelecypoda, gastropoda, Cephalopoda – orders - Nautiloidea, Ammonoidea, Dibranchia – Belemnites. |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Phylum – Brachiopoda, Phylum –                                                                                                                                    |          |   |   |   |   |         | 12           | CO3               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                            |               |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Coelenterata.ClassAnthozoa – Subclass Zoantharia<br>Orders Rugosa, Tabulata and Scaleractina. Phylum –<br>Hemichordata – Class Graptozoa, order Dendroidea,<br>Order Graptolitoidea.                                                       |               |     |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Phylum – Arthropoda Class – Trilobita Phylum –<br>Echinodermata Class - Echinoidea Class – Crinoidea.<br>Class: Blastoidea. Introduction to Paleobotany,<br>Gondwana Flora.                                                                | 12            | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Short account of the following Dinosaurs, Saurischian<br>Dinosaur and Ornithistian Dinosaurs, Archaeopteryx,<br>Elementary idea of Verterbrate fossils of India,<br>Morphological character of Phylum – Protozoa, Order –<br>Foraminifera. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                                                                      | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                                                                            |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                            |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                                                                                                                               |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basics of Fossils                                                                                                                                                                                                           | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of fossils in Geological studies                                                                                                                                                                                 | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know different phulum and their species with morphological changes                                                                                                                                                                         | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand and correlate fossil with various rock formations                                                                                                                                                                               | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of Palaeontology in dating and evolution studies                                                                                                                                                                 | PO3, PO8      |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                            |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Palaeontology Evolution and animal distribution. .C. Jain and M.S. Anantharaman, (1996), Vishal Publications, Jalandhar.                                                                                                                   |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Invertebrate Palaeontology - H.Woods, (1985), CBS Publishers and Distributors, New Delhi.                                                                                                                                                  |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Agashe, S.N, Paleo botany, Oxford & IBH. Delhi(1995)                                                                                                                                                                                       |               |     |

|                                                                                                 |                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.                                                                                              | Stewart W.N. & G.W. Rothwell, Palaeobotany, Cambridge University Press. D (2005)                                                                            |
| 5.                                                                                              | Moore R.C. et al., Invertebrate Fossils. CBS. Delhi (1952).                                                                                                 |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                             |
| 1.                                                                                              | Principles of Invertebrate Palaeontology, Shrock R.R and Twenohofel W.H, (2005), CBS Publishers and Distributors, New Delhi.                                |
| 2.                                                                                              | Invertebrate Fossils. Moore R.C, Lalicker C.G and Fisher A.G (1952) McGraw Hill.                                                                            |
| 3.                                                                                              | The Vertebrate Story, Romer A.S, (1959) University of Chicago Press, 4 <sup>th</sup> Edt. Chicago.                                                          |
| 4.                                                                                              | Palaeontology An Introduction, E.W.Nield and V.C.T.Tucker (1985) Pergamon Press, Oxford.                                                                    |
| 5.                                                                                              | Colbert E.H. et al., Evolution of the Vertebrates, Wiley. New Delhi 2002)                                                                                   |
| Web Resources                                                                                   |                                                                                                                                                             |
| 1.                                                                                              | "Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005. Retrieved 2006-01-10.                                     |
| 2.                                                                                              | Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London. |
| 3.                                                                                              | Digitalatlas.cose.ISU.edu>geo>basics>fossil                                                                                                                 |
| 4.                                                                                              | <a href="http://www.sciencedirect.com&gt;topic&gt;hemichordata">www.sciencedirect.com&gt;topic&gt;hemichordata</a>                                          |
| 5.                                                                                              | w.qm.qid.au>biodiscovery>corals                                                                                                                             |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                  | Sec | L | T | P | S | d | .H           | Marks |                   |       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---|---|---|---|---|--------------|-------|-------------------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                               |     |   |   |   |   |   |              | CIA   | External          | Total |
| 23UGESO01         | Basics of Earth Science                                                                                                                                                                                                                                                                                                                       | SEC | Y | - | - | - | 2 | 2            | 25    | 75                | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                               |     |   |   |   |   |   |              |       |                   |       |
| CO1               | The main objective of this course is to understand various properties of Earth.                                                                                                                                                                                                                                                               |     |   |   |   |   |   |              |       |                   |       |
| CO2               | To describe the concepts of internal structure of the Earth                                                                                                                                                                                                                                                                                   |     |   |   |   |   |   |              |       |                   |       |
| CO3               | To explain various components related to external processes of Earth                                                                                                                                                                                                                                                                          |     |   |   |   |   |   |              |       |                   |       |
| CO4               | To study concepts of various currents and atmospheric circulation.                                                                                                                                                                                                                                                                            |     |   |   |   |   |   |              |       |                   |       |
| CO5               | To understand the availability of elements in the Earth.                                                                                                                                                                                                                                                                                      |     |   |   |   |   |   |              |       |                   |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                       |     |   |   |   |   |   | No. of Hours |       | Course Objectives |       |
| I                 | Universe – Evolution of the Universe. Solar System – Inner and outer planets – characteristics of solar system. Satellites – Asteroids – Meteors – comets. Earth – movements – revolution – rotation – solstice – equinox. Atmosphere - El Nino – hydrosphere – lithosphere- Origin of the Earth.                                             |     |   |   |   |   |   | 12           |       | CO1               |       |
| II                | Age of the Earth - old methods – new methods – Radioactivity – Half-life period – Radiometric methods. Interior of the Earth – Density – Shape – Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity.                                                  |     |   |   |   |   |   | 12           |       | CO2               |       |
| III               | Introduction to Geomorphology: Geological action of wind, water, glaciers and ground water. Volcanoes and earthquakes. Rock deformation: Folds, Faults, Joints, Cleavage, Unconformities, Concepts of plate tectonics, sea floor spreading and geosynclines.                                                                                  |     |   |   |   |   |   | 12           |       | CO3               |       |
| IV                | Study of Fossils- Introduction, Geological Record and its nature. Geological Time Scale. Introduction, Definition of Paleontology, Classification of Plants, Invertebrate and Vertebrate fossils. Fossils -Tophonomy (Burial Law), Types of Fossilization, Mode of preservation- Applications of Fossils– National fossil parks across India. |     |   |   |   |   |   | 12           |       | CO4               |       |
| V                 | Applications of Geology:Environmental impacts due to mining and mineral process, Engineering Geology: Dams, Reservoirs and Tunnels, strategic, critical and essential mineral –Mineral resources of India. Fossil Fuels and Groundwater.                                                                                                      |     |   |   |   |   |   | 12           |       | CO5               |       |
|                   | Total                                                                                                                                                                                                                                                                                                                                         |     |   |   |   |   |   | 60           |       |                   |       |

|                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. The blooms taxonomy verbs will be given as a separate annexure for your reference.</b> |                                                                                                                                                                    |               |
| <b>Each course outcome should be mapped with the POs.</b>                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                    |               |
| <b>The mapping of each CO can be done with any number of POs.</b>                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                    |               |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                    |               |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                            | On completion of this course, students will;                                                                                                                       |               |
| <b>CO1</b>                                                                                                                                                                                                                                                                                                                                                        | Gather basic information on Earth Sciences                                                                                                                         | PO1           |
| <b>CO2</b>                                                                                                                                                                                                                                                                                                                                                        | Understand the importance of various components of Earth                                                                                                           | PO1, PO2      |
| <b>CO3</b>                                                                                                                                                                                                                                                                                                                                                        | Process of Geomorphological features                                                                                                                               | PO4, PO6      |
| <b>CO4</b>                                                                                                                                                                                                                                                                                                                                                        | Understand, predict and analyze the fossil and dating                                                                                                              | PO4, PO5, PO6 |
| <b>CO5</b>                                                                                                                                                                                                                                                                                                                                                        | Apply the geological knowledge in various civil structures                                                                                                         | PO3, PO8      |
| <b>Text Books<br/>(Latest Editions)</b>                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                    |               |
| 1.                                                                                                                                                                                                                                                                                                                                                                | Mineralogy – Dexter Perkins (2014), 3rd edition, Pearson New International Edition.                                                                                |               |
| 2.                                                                                                                                                                                                                                                                                                                                                                | Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.                                                              |               |
| 3.                                                                                                                                                                                                                                                                                                                                                                | Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)                                                                                               |               |
| 4.                                                                                                                                                                                                                                                                                                                                                                | Mukherjee A.K, Principles of Geology, EW Press, Kolkata(1990)                                                                                                      |               |
| 5.                                                                                                                                                                                                                                                                                                                                                                | Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005)                                                                                     |               |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b>                                                                                                                                                                                                                                                           |                                                                                                                                                                    |               |
| 1.                                                                                                                                                                                                                                                                                                                                                                | Introduction to Mineralogy – William D. Nesse (2000), Oxford University press, New York. USA.                                                                      |               |
| 2.                                                                                                                                                                                                                                                                                                                                                                | Textbook of Mineralogy – E.S. Dana, (2000), 3rd edition, CBS Publishers & Distributers, New Delhi.                                                                 |               |
| 3.                                                                                                                                                                                                                                                                                                                                                                | Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.                                                                          |               |
| 4.                                                                                                                                                                                                                                                                                                                                                                | Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer                                                            |               |
| 5.                                                                                                                                                                                                                                                                                                                                                                | Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)                                                                                             |               |
| <b>Web Resources</b>                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                    |               |
| 1.                                                                                                                                                                                                                                                                                                                                                                | <i>"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005. Retrieved 2006-01-10.</i>                                     |               |
| 2.                                                                                                                                                                                                                                                                                                                                                                | <i>Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.</i> |               |
| 3.                                                                                                                                                                                                                                                                                                                                                                | Geo.libretexts.org                                                                                                                                                 |               |
| 4.                                                                                                                                                                                                                                                                                                                                                                | www.nationalgeographic.org                                                                                                                                         |               |
| 5.                                                                                                                                                                                                                                                                                                                                                                | Solarsysytem.nasa.gov                                                                                                                                              |               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

#### Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3)    M-Medium (2)    L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                              | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT04         | MINING GEOLOGY                                                                                                                                                                                                                                                                                                                            | Core     | Y | - | - | - | 5       | 5            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics components of Structural Geology                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Know the formations of geological formations                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Basics of Aerial Photographs                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the Application of Satellite science                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Analyse various physiographical features through GIS                                                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Mining terms and their descriptions. Sampling - Principles - Types of sampling - Collection & preparation of samples. Drilling: Types of drills and methods of drilling. Geological logging. Explosives and Blasting Methods. Rock excavations. Assaying and evaluation of ore-bodies and their extensions-ore reserve estimation         |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Role of geology in mining industries - definition of mining terms, shaft, Hanging wall, Adit, roof, Drive crosscut, Tunnel, Raise, Winze, Stope, Ventilation, Haulage; Surface methods of mining, Alluvial mining - pan & betea, sluicing, Hydraulicking, Drift mining and Dredging. opencast mining. Benches, Explosives, working slope, |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Mining equipments - Dragline, Mine machinery-power shovel, bucket wheel excavator, conveyor and spreader Top slicing. Sublevel caving and Block caving. Coal mining (surface mining) Strip mining and Augering- transportation -cleaning -Grading - Shipping.                                                                             |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Underground mining. Room and pillar method- Longwall method- hydraulicking.                                                                                                                                                                                                                                                               |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                  |               |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Mineral Economics and its concept. Role of Minerals in National Economy.. Mineral conservation and substitution                                                                                                                                  |               |     |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Types of mining- Glory hole, Kaolin mining, Granite mining, sand mining, stripping. Ground water control -Power source roofing - Mining and environment, Mitigation of mining hazards. Factors controlling the choice of various mining methods. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total                                                                                                                                                                                                                                            | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                                  |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | On completion of this course, students will;                                                                                                                                                                                                     |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the basics components of Structural Geology                                                                                                                                                                                           | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Know the formations of geological formations                                                                                                                                                                                                     | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Basics of Aerial Photographs                                                                                                                                                                                                                     | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the Application of Satellite science                                                                                                                                                                                                  | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Analyse various physiographical features through GIS                                                                                                                                                                                             | PO3, PO8      |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                  |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1. Curran, P (1988). Principles of remote sensing. Corgman Publishers, London                                                                                                                                                                    |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lillesand, T.M and R.W. Kiefer (2000). Remote sensing and image interpretation. John Wiley & Miller, V.C (1961). Photogeology. McGraw-Hill Publishers, New York                                                                                  |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | . Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd.,New Delhi                                                                                                                                                  |               |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sabins, F.F (1987). Remote sensing principles and interpretation. Freeman Publishers,New York                                                                                                                                                    |               |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Siegal, B.S and R. Gillespie (1980). Remote sensing in Geology, John Wiley & Sons,New York                                                                                                                                                       |               |     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                  |               |     |

|               |                                                                                          |
|---------------|------------------------------------------------------------------------------------------|
| 1.            | Arogyaswamy, R.N.P. Courses in Mining Geology - Oxford & IBH, New Delhi.                 |
| 2.            | Thamus, P.J. 1979 An introduction to mining, Methun.                                     |
| 3.            | Mc Kinstry, H.E 1960 Mining Geology, New york.                                           |
| 4.            | Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford.     |
| 5.            | Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi |
| Web Resources |                                                                                          |
| 1.            |                                                                                          |
| 2.            |                                                                                          |
| 3.            |                                                                                          |
| 4.            |                                                                                          |
| 5.            |                                                                                          |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2) L-Low (1)

| Subject Code                                                                                                                                                                                                                                                            | Subject Name                                                                                                                                                                                                                                                         | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT05                                                                                                                                                                                                                                                               | GEOMORPHOLOGY AND GEOTECTONICS                                                                                                                                                                                                                                       | Core     | Y | - | - | - | 5       | 5            | 25                | 75       | 100   |
| Course Objectives                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO1                                                                                                                                                                                                                                                                     | Know the basics of Geotectonics and landforms                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO2                                                                                                                                                                                                                                                                     | Understand the importance of various geomorphological agencies                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO3                                                                                                                                                                                                                                                                     | Process of Geomorphological features and creation of landforms                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO4                                                                                                                                                                                                                                                                     | Understand and predict Earth's Internal and external processes                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO5                                                                                                                                                                                                                                                                     | Predict the future from the past formed features                                                                                                                                                                                                                     |          |   |   |   |   |         |              |                   |          |       |
| UNIT                                                                                                                                                                                                                                                                    | Details                                                                                                                                                                                                                                                              |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                                                                                                                                                                                                                                                                       | Interpretation of fluvial cycle - Landforms developed by running water – valley development, river capture, waterfalls, meandering, river terraces, Lakes, their types and deposits. Geological work of wind and Underground water.                                  |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                                                                                                                                                                                                                                                                      | Glaciers – formation, movement, types and landforms due to their erosional and transportational activity. Topography of ocean floor –erosional and depositional features of oceans – Coral reefs, types, theories for the origin of coral reefs – Submarine Canyons. |          |   |   |   |   |         | 12           | CO2               |          |       |
| III                                                                                                                                                                                                                                                                     | Mountains – their kinds, development and important mountain building movements. Processes of weathering – types and products- Mass Movements.                                                                                                                        |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                                                                                                                                                                                                                                                                      | Earthquakes – types – seismographs – intensity and Magnitude scales (Richter & Mercalli) –Tsunami-Global Distribution; Volcanoes – structure, types – products – Global Distribution .                                                                               |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                                                                                                                                                                                                                                                                       | Continental drift – Wegner Concept – various evidences. Plate tectonics – concept – plate characteristics – larger and smaller plates – types of plate boundaries – causes and mechanism of plate motions.                                                           |          |   |   |   |   |         | 12           | CO5               |          |       |
|                                                                                                                                                                                                                                                                         | Total                                                                                                                                                                                                                                                                |          |   |   |   |   |         | 60           |                   |          |       |
| The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. |                                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |

The blooms taxonomy verbs will be given as a separate annexure for your reference.  
Each course outcome should be mapped with the POs.  
The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes | On completion of this course, students will;                   |               |
|-----------------|----------------------------------------------------------------|---------------|
| CO1             | Know the basics of Geotectonics and landforms                  | PO1           |
| CO2             | Understand the importance of various geomorphological agencies | PO1, PO2      |
| CO3             | Process of Geomorphological features and creation of landforms | PO4, PO6      |
| CO4             | Understand and predict Earth's Internal and external processes | PO4, PO5, PO6 |
| CO5             | To fit the curve using geological data.                        | PO3, PO8      |

#### Text Books (Latest Editions)

|    |                                                                                                   |
|----|---------------------------------------------------------------------------------------------------|
| 1. | Worcester ,P.G.,A Text Book of Geomorphology, East West Press Ltd.Delhi.(1960)                    |
| 2. | SathyaNarayanaswami,B.S. Structural Geology. DhanpatRai& Sons. New Delhi.(1994)                   |
| 3. | Gokhale,N.W. , Theory of Structural Geology, CBS, Delhi(1995)                                     |
| 4. | . Davis,G.H, Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley(1985) |
| 5. | Ragan D.M., Structural Geology-An Introduction to geometrical Techniques. Wiley. New York(2000)   |

#### References Books

(Latest editions, and the style as given below must be strictly adhered to)

|    |                                                                            |
|----|----------------------------------------------------------------------------|
| 1. | Hills E.S., Elements of Structural Geology, Chapman &Hall. London(1963)    |
| 2. | Mahapatra G.B. Textbook of PhysicalGeology, CBS publications, Delhi(1994). |
| 3. | Park,P.G., Foundations of Structural Geology, Blackie. London (1983).      |
| 4. | Radhakrishnan V, General Geology, V.V.P. Publications, Tuticorin(1996),    |
| 5. | Bloom A., Principles of Geomorphology (1985).                              |

#### Web Resources

|    |                                                                                             |
|----|---------------------------------------------------------------------------------------------|
| 1. | <a href="http://www.labotka.net">http://www.labotka.net</a>                                 |
| 2. | <a href="http://www.patnasciencecollege.org">http://www.patnasciencecollege.org</a>         |
| 3. | <a href="https://geomorphology.org.uk">https://geomorphology.org.uk</a>                     |
| 4. | <a href="https://gradeup.co">https://gradeup.co</a>                                         |
| 5. | <a href="https://www.nps.gov&gt;subjects&gt;gla">https://www.nps.gov&gt;subjects&gt;gla</a> |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                 | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGESO02         | Principles of Surveying (Entrepreneurship)                                                                                                                                                                                                                                                                                   | SEC      | Y | - | - | - | 1       | 1            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO1               | To learn about the principles of surveying, sources and errors.                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To know about the components and procedures of Prismatic Compass and Traverse survey.                                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know about the levelling procedures, instruments and its applications.                                                                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the principles, adjustments, methods of Plane Table Survey.                                                                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To acquire the knowledge about the Total Station Survey and its merits and demerits.                                                                                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Surveying: Introduction – objectives – Uses - Classification –Principle of Surveying - Units of measurements – Errors – Sources, Types of errors and their corrections – accuracy and precision, Stages of survey operations – Methods of Linear Measurement – Distance measurement devices: Ranging rod, Chain, tape.       |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Measurement of Angles and Directions – Definitions - Meridians – Bearings – Magnetic and True bearings – Azimuth. Prismatic Compass: Components -Adjustment of the compass: Centering, Levelling, and focusing the prism. Traverse: Types of the traverse –procedures – Control establishments –Adjustment of closing error. |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Levelling and its application: Introduction to Levelling – Methods - Types of instruments –Description of Dumpy level: Temporary adjustment of level. Auto levelling: Types – Parts – Operation – Merits and demerits.                                                                                                       |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Table Surveying: Definition - Principles – Accessories – Temporary adjustments – Setting up the Plane Table - Methods of Plane table surveying: Radiation, Intersection, Traversing & Resection methods.                                                                                                                     |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                            |               |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Advantages, disadvantages and Errors in Plane Tabling.                                                                                                                                                                                     |               |     |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Total Station Survey: Introduction – Features: Linear, Angle and Height measurements – Accessories – Setting-up and orientation - Types of error and error correction – Advantages and disadvantages of TSS. Introduction to Drone Survey. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total                                                                                                                                                                                                                                      | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                            |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | On completion of this course, students will;                                                                                                                                                                                               |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Gain the knowledge over principles, various errors and types of surveying.                                                                                                                                                                 | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Ability to know the measurement of angles and direction using Prismatic Compass survey.                                                                                                                                                    | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Gaining knowledge about levelling instruments and its applications.                                                                                                                                                                        | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Complete understating the Plane Table survey.                                                                                                                                                                                              | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the concept of recent techniques of Total Station                                                                                                                                                                               | PO3, PO8      |     |

### Outcome Mapping

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PS01 | PS02 | PS03 | PS04 | PS05 | PS06 | PS07 |
|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | √   |     |     |     |     | √    | √    |      |      |      |      |      |
| CO2 | √   |     |     |     |     |      | √    |      |      |      |      |      |
|     |     |     |     |     |     |      |      |      |      |      |      |      |
|     |     |     |     |     |     |      |      |      |      |      |      |      |
| CO5 |     |     | √   | √   |     |      |      |      |      |      | √    | √    |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 3    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code             | Subject Name                                                                        | Category | L | T | P | S | Credits | Inst. Hours | Marks |          |       |
|--------------------------|-------------------------------------------------------------------------------------|----------|---|---|---|---|---------|-------------|-------|----------|-------|
|                          |                                                                                     |          |   |   |   |   |         |             | CIA   | External | Total |
| 23UGESO05                | GEOHAZARDS                                                                          | SEC      | Y | 5 | - | - | 2       | 2           | 25    | 75       |       |
| <b>Course Objectives</b> |                                                                                     |          |   |   |   |   |         |             |       |          |       |
| CO1                      | To explain students about the physical and geological processes causing geohazards. |          |   |   |   |   |         |             |       |          |       |
| CO2                      | To discuss the methods for quantifying geohazards.                                  |          |   |   |   |   |         |             |       |          |       |
| CO3                      | To understand the possible consequences as well as risk and disaster management.    |          |   |   |   |   |         |             |       |          |       |
| CO4                      | Aware the geological and physical process were to be discussed.                     |          |   |   |   |   |         |             |       |          |       |

| CO5      | Different types of geohazards, disaster prevention and management.                                                                                                                                                                                                                                                       |              |                   |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------|
| UNIT     | Details                                                                                                                                                                                                                                                                                                                  | No. of Hours | Course Objectives |
| UNIT I   | Natural Hazard – Definition – Earth's processes: catastrophic geological hazards: study of floods, tsunamis, Landslides, Earthquakes, Volcanism and avalanches – with a view to assess the magnitude of the problem, prediction and perception of the hazards. Laws and regulations towards hazard management.           | 12           | CO1               |
| UNIT II  | Earthquakes-Definition–focus-epicenter-seismic waves-intensity and magnitude-Richter scales–Tsunami-Seismograph-seismogram-seismicity in Indian region-Seismic gaps- mitigation measures and management. Preparation of seismic hazard map.                                                                              | 12           | CO2               |
| UNIT III | Volcanoes-Definition-structure - types– Global distribution- mitigation measures and management. Avalanche –Definition–types–mitigation.- Definition- causes - vulnerable zones in India-Mitigation measures and management.Coastal erosion– its causes-mitigation measures and management.                              | 12           | CO3               |
| UNIT IV  | Landslides-types-slow flowage, rapid flowage, sliding and subsidence – causes and mechanism-Vulnerable zones in India-mitigation measures and management. Deforestation and land degradation-Cyclone- Definition-causes - vulnerable zones in India-mitigation measures and management.                                  | 12           | CO4               |
| UNIT V   | Mass movement – factor influencing slope stability – types of mass movement – hazards of mass movement – strategies for their reduction and the role of geology. Soil erosion – Soil formation – soil classification – factor influencing soil erosion – hazards of soil erosion – Drought – types, mitigation measures. | 12           | CO5               |

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.

The blooms taxonomy verbs will be given as a separate annexure for your reference.

Each course outcome should be mapped with the POs.

The mapping of each CO can be done with any number of POs.

#### Course Outcomes

|                                                                                    |                                                                                                                        |               |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------|
| Course Outcomes                                                                    | On completion of this course, students will;                                                                           |               |
| CO1                                                                                | Explain the physical and geological processes causing geohazards such as landslides, floods, tsunamis and earthquakes. | PO1           |
| CO2                                                                                | Describe methods for quantifying hazard for the individual geohazards and factors controlling their uncertainty.       | PO1, PO2      |
| CO3                                                                                | Explain possible consequences of geohazards as well as risk and disaster management.                                   | PO4, PO6      |
| CO4                                                                                | Complete a basic hazard assessment for selected geohazards.                                                            | PO4, PO5, PO6 |
| CO5                                                                                | Gain an additional knowledge on possible interactions between geohazards and their consequences                        | PO3, PO8      |
| <b>Text Books</b>                                                                  |                                                                                                                        |               |
| <b>(Latest Editions)</b>                                                           |                                                                                                                        |               |
| 1.                                                                                 | Geology, environment, Society K.S. Valdiya (2004) Universities Press (India) Private Limited, Hyderabad, India         |               |
| 2.                                                                                 | Coping with natural hazards: Indian context K.S. Valdiya (2004) Orient Longman Private Limited, Hyderabad, India.      |               |
| 3.                                                                                 | Engineering and general geology Parbin Singh (2003) S.K. Kataria and sons Delhi India                                  |               |
| <b>References Books</b>                                                            |                                                                                                                        |               |
| <b>(Latest editions, and the style as given below must be strictly adhered to)</b> |                                                                                                                        |               |
| 1.                                                                                 | General Geology V. Radhakrishnan (1996) V.V.P. Publishers, Tuticorin, India.                                           |               |
| 2.                                                                                 | Lundgren (1986). Environment Geology, Rentice Hall Publishers, New Jersey.                                             |               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| CO1 | 2   | 1   | 3   | 1   | 3   |
| CO2 | 2   | 1   | 2   | 3   | 1   |
| CO3 | 3   | 2   | 2   | 2   | 2   |
| CO4 | 2   | 2   | 3   | 1   | 2   |
| CO5 | 3   | 2   | 1   | 2   | 3   |

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                         | Category | L | T | P | S | Credits      | Inst. Hours | Marks             |          |       |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|--------------|-------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |              |             | CIA               | External | Total |
| 23UGECT06         | STRUCTURAL GEOLOGY AND PHOTO GEOLOGY                                                                                                                                                                                                                                                                                                 | Core     | Y | - | - | - | 5            | 5           | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |              |             |                   |          |       |
| CO1               | Understand the basics components of Structural Geology                                                                                                                                                                                                                                                                               |          |   |   |   |   |              |             |                   |          |       |
| CO2               | Know the formations of geological formations                                                                                                                                                                                                                                                                                         |          |   |   |   |   |              |             |                   |          |       |
| CO3               | Basics of Aerial Photographs                                                                                                                                                                                                                                                                                                         |          |   |   |   |   |              |             |                   |          |       |
| CO4               | Understand the Application of Satellite science                                                                                                                                                                                                                                                                                      |          |   |   |   |   |              |             |                   |          |       |
| CO5               | Analyse various physiographical features through GIS                                                                                                                                                                                                                                                                                 |          |   |   |   |   |              |             |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   | No. of Hours |             | Course Objectives |          |       |
| I                 | Definition and scope of structural geology – topographic forms – topographic map – geological map – contour lines – stratum contours – outcrops and exposures. Attitude of beds – dip and strike – slope – Clinometer, Brunton compass and GPS (Global Positioning System) and its uses.                                             |          |   |   |   |   | 12           |             | CO1               |          |       |
| II                | Fold: Definition and parts of fold; classification of folds. Joints: Description and classification. Description and origin of foliations and lineations.                                                                                                                                                                            |          |   |   |   |   | 12           |             | CO2               |          |       |
| III               | Fault: Definition and parts of fault; classification of faults – Horst – Graben – Nappe – Fenster – Klippe – overthrust. Unconformity: Definition – types of unconformity – inlier and outlier.                                                                                                                                      |          |   |   |   |   | 12           |             | CO3               |          |       |
| IV                | Aerial Remote Sensing: Definition and scope of photogeology - Aerial photographs – types – geometry of aerial photographs – tip and tilt – nadir point – principal point – fiducial marks – scale of photographs – vertical exaggeration – Stereoscopy – pocket lens and mirror stereoscope – mosaics – controlled and uncontrolled. |          |   |   |   |   | 12           |             | CO4               |          |       |
| V                 | Satellite Remote Sensing – Principles of Remote Sensing – Components of remote sensing system Electro Magnetic Radiations (EMR) – Satellites – Sensors and platforms – Indian and foreign Satellites. Introduction to Geographic Information System (GIS); components of GIS;                                                        |          |   |   |   |   | 12           |             | CO5               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                              |               |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | productgeneration in GIS; tools for map analysis;<br>integration of GIS and remote sensing                   |               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                        | 60            |  |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                              |               |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                              |               |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                 |               |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basics components of Structural Geology                                                       | PO1           |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the formations of geological formations                                                                 | PO1, PO2      |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Basics of Aerial Photographs                                                                                 | PO4, PO6      |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the Application of Satellite science                                                              | PO4, PO5, PO6 |  |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Analyse various physiographical features through GIS                                                         | PO3, PO8      |  |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                              |               |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Structural geology, Billing. M.P. (1974), Prentice Hall, New Delhi                                           |               |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | An outline of Structural Geology, Hobbs, B.E., Means, W.D. and Williams, P.F. (1976);, John Wiley, New York. |               |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Curran P.B, Principles of Remote Sensing, ELBS. London(1985).                                                |               |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sabins F.F, Remote Sensing Principles and Interpretation. Freeman. New York(1974)                            |               |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)                                              |               |  |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                              |               |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Basic Problems of GeotectonicsBelousov.V.V. (1962);, McGraw Hill, New York                                   |               |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Structural GeologyDe Sitter. L.U. (1956);, McGraw Hill, New York                                             |               |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Elements of Structural GeologyHill. E.S. (1972);, John Wiley, New York                                       |               |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Aerial Photographic InterpretationLueder.D.R. (1959);, McGraw Hill, New York.                                |               |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lillisand T.M &R.W.Kiefer, Remote Sensing and Image Interpretation, WileDelhi(2000)                          |               |  |
| Web Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                              |               |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <a href="https://stratigraphy.org/">https://stratigraphy.org/</a>                                            |               |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <a href="https://www.sepm.org/">https://www.sepm.org/</a>                                                    |               |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>                                      |               |  |

|    |                                                                 |
|----|-----------------------------------------------------------------|
| 4. | <a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a> |
| 5. | <a href="https://isegindia.org/">https://isegindia.org/</a>     |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |
|      |      |      |      |      |      |      |      |      |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code             | Subject Name                                                                                                                                                             | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                          |                                                                                                                                                                          |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGCECP02               | Structural Geology, Remote Sensing and Survey Practical                                                                                                                  | Core     | Y | - | - | - | 3       | 3            | 40                | 60       | 100   |
| <b>Course Objectives</b> |                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO1                      | Understand the basics components of Structural Geology                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO2                      | Know the formations of geological formations                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |
| CO3                      | Basics of Aerial Photographs                                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |
| CO4                      | Understand the Application of Satellite science                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO5                      | Analyse various physiographical features through GIS                                                                                                                     |          |   |   |   |   |         |              |                   |          |       |
| UNIT                     | Details                                                                                                                                                                  |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                        | Contour Maps and their interpretation – Exercises to find out trend of the outcrop of horizontal, vertical, inclined beds with respect to topography – Reading of solid, |          |   |   |   |   |         | 12           | CO1               |          |       |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|
|     | conformable maps – Deciphering dip and strike of outcrops - Completion of map when three points over a bedding plane are given – Determination of vertical thickness of formations.                                                                                                                                                                                                                                                            |           |     |
| II  | Reading of solid fold and fault maps – Determination of throw of faults – Construction of vertical sections – Reading of unconformable solid maps – Construction of sections – Reading of solid maps of areas with more than one structure and intrusion – Writing of geological history.                                                                                                                                                      | 12        | CO2 |
| III | Solving of dip and strike problems by trigonometrical method – Determination of true thickness of beds by calculations                                                                                                                                                                                                                                                                                                                         | 12        | CO3 |
| IV  | Interpretation of geomorphology, lithology and geological structures on aerial photographs. Visit to nearby geological organizations                                                                                                                                                                                                                                                                                                           | 12        | CO4 |
| V   | Definition – Primary divisions – classification – Chain survey – description of instruments employed – chain traverse – Compass survey – description of prismatic compass – whole circle bearings – reduced bearings – quadrantal bearings – open traverse – closed traverse – finding distance between inaccessible stations – locating the instrument station - GPS - Clinometer compass – finding dip and strike of beds – Modern Surveying | 12        | CO5 |
|     | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>60</b> |     |

**The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.**

**The blooms taxonomy verbs will be given as a separate annexure for your reference.**

**Each course outcome should be mapped with the POs.**

**The mapping of each CO can be done with any number of POs.**

#### **Course Outcomes**

| <b>Course Outcomes</b> | On completion of this course, students will;          |               |
|------------------------|-------------------------------------------------------|---------------|
| <b>CO1</b>             | Understand the basic components of Structural Geology | PO1           |
| <b>CO2</b>             | Know the formations of geological formations          | PO1, PO2      |
| <b>CO3</b>             | Basics of Aerial Photographs                          | PO4, PO6      |
| <b>CO4</b>             | Understand the Application of Satellite science       | PO4, PO5, PO6 |

|                                                                                                         |                                                                                                                |          |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------|
| <b>CO5</b>                                                                                              | Analyse various physiographical features through GIS                                                           | PO3, PO8 |
| <b>Text Books<br/>(Latest Editions)</b>                                                                 |                                                                                                                |          |
| 1.                                                                                                      | GokhaIe,N.W. , Theory of Structural Geology, CBS, Delhi(1995)                                                  |          |
| 2.                                                                                                      | Sathya Narayanaswami,B.S. Structural Geology. Dhanpat Rai & Sons. New Delhi.(1994)                             |          |
| 3.                                                                                                      | Lillisand T.M &R.W.Kiefer, Remote Sensing and Image Interpretation, WileDelhi(2000)                            |          |
| 4.                                                                                                      | Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)                                                |          |
| 5.                                                                                                      | Subramanian, Surveying and Levelling,Oxford University Press(2 <sup>nd</sup> edition)                          |          |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b> |                                                                                                                |          |
| 1.                                                                                                      | Park,P.G., Foundations of Structural Geology, Blackie. London (1983).                                          |          |
| 2.                                                                                                      | Mahapatra G.B. Textbook of PhysicalGeology, CBS publications, Delhi(1994).                                     |          |
| 3.                                                                                                      | Ragan D.M., Structural Geology-An Introduction to geometrical Techniques. Wiley. New York(2000)                |          |
| 4.                                                                                                      | Guptha,R.P, Remote Sensing Geology, Springer New Delhi(2003)                                                   |          |
| 5.                                                                                                      | T.P. Kanetkarand S.V .Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune Vidyarthi GrihaPrakashan 2006 |          |
| <b>Web Resources</b>                                                                                    |                                                                                                                |          |
| 1.                                                                                                      | <a href="http://www.labotka.net">http://www.labotka.net</a>                                                    |          |
| 2.                                                                                                      | <a href="http://www.patnasciencecollege.org">http://www.patnasciencecollege.org</a>                            |          |
| 3.                                                                                                      | <a href="http://www.wamis.org">www.wamis.org</a>                                                               |          |
| 4.                                                                                                      | <a href="http://www.sciencedirect.com">www.sciencedirect.com</a> >earth-and-planetaryh-sciences                |          |
| 5.                                                                                                      | <a href="https://www.geo.cornell.edu">https://www.geo.cornell.edu</a>                                          |          |

**In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.**

**The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.**

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

#### **Mapping with Programme Outcomes:**

|             | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO 1</b> | 3           | 3           | 2           | 3           | 3           | 3           | 2           | 2           |
| <b>CO 2</b> | 2           | 3           | 3           | 3           | 3           | 3           | 3           | 3           |
| <b>CO 3</b> | 3           | 3           | 3           | 3           | 3           | 3           | 2           | 1           |
| <b>CO 4</b> | 3           | 3           | 3           | 3           | 3           | 2           | 1           | 1           |
| <b>CO 5</b> | 2           | 1           | 1           | 2           | 1           | 1           | 2           | 2           |

**S-Strong(3)    M-Medium (2)       L-Low (1)**

| Subject Code      | Subject Name                                                                                                                                                                                                                         | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                      |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGESO04         | <b>FIELDHYDROGEOLOGY AND TECHNIQUES</b>                                                                                                                                                                                              | SE<br>C  | Y | - | - | - | 2       | 2            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO1               | To impart knowledge of basic field hydrogeology including groundwater origin, occurrence and distribution.                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To train students on basics of Calculation of Porosity and Permeability, Pump Test data, Calculation of Groundwater Fluctuations.                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO3               | To train students on basics of well hydraulics, method of exploration, water budget and management.                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO4               | To impart theoretical, practical and field knowledge pertaining to Hydrogeological domain.                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To understand the relationship between water and rock interaction and salt water intrusion and its remedial measures in the coastal aquifers.                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                              |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | <b>Importance of Hydrology</b> – Difference between Hydrogeology and Hydrology, Water Bearing Geologic formations. Groundwater Provinces of Tamil Nadu. Collection of Rainfall data. Short account on Thiessen Polygon Isohyet maps. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | <b>Hydrogeologic Parameters:</b> Calculation of Porosity and Permeability, Pump Test data, Calculation of Groundwater Fluctuations.                                                                                                  |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | <b>Wells</b> – Well Inventory Survey: Water level, Water level Fluctuation, Subsurface Layers (Soil thickness, Weathered zone, Fractured zone, Bed rock) - Well construction - Well logging -                                        |          |   |   |   |   |         | 12           | CO3               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|-----------------|----------------------------------------------|--|--|-----|--|-----|--|-----|--|----------|--|-----|--|----------|--|-----|--|---------------|--|-----|--|----------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Sedimentary aquifers: Sandstone, limestone.                                                                                                                                                 |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Hardrock Aquifers:</b> Charnockites, Gneiss, Granite formation - Field observation and Measurement of Soil moisture zone, Zone of Aeration, Zone of saturation.                          | 12            | CO4 |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Pumping Test:</b> Yield, Drawdown, Recuperation, Transmissivity, Permeability. Case studies: Rainfall in Salem district, Groundwater condition in Salem district. Rain Water Harvesting. | 12            | CO5 |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Total                                                                                                                                                                                       | 60            |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> <table><tr><td>Course Outcomes</td><td colspan="3">On completion of this course, students will;</td></tr><tr><td>CO1</td><td></td><td colspan="2">PO1</td></tr><tr><td>CO2</td><td></td><td colspan="2">PO1, PO2</td></tr><tr><td>CO3</td><td></td><td colspan="2">PO4, PO6</td></tr><tr><td>CO4</td><td></td><td colspan="2">PO4, PO5, PO6</td></tr><tr><td>CO5</td><td></td><td colspan="2">PO3, PO8</td></tr></table> |                                                                                                                                                                                             |               |     | Course Outcomes | On completion of this course, students will; |  |  | CO1 |  | PO1 |  | CO2 |  | PO1, PO2 |  | CO3 |  | PO4, PO6 |  | CO4 |  | PO4, PO5, PO6 |  | CO5 |  | PO3, PO8 |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | On completion of this course, students will;                                                                                                                                                |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             | PO1           |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             | PO1, PO2      |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             | PO4, PO6      |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             | PO4, PO5, PO6 |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             | PO3, PO8      |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A Textbook of Groundwater-2000-P. Arul, Dhanam Agency, 99D, Bazaar Street, Virudachalam-606001.                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Groundwater Hydrology-1959-David K. Todd-John Wiley & Sons, New York. Ragunath, H.M. 1987, Groundwater, Wiley Eastern Ltd., New Delhi.                                                      |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                             |               |     |                 |                                              |  |  |     |  |     |  |     |  |          |  |     |  |          |  |     |  |               |  |     |  |          |  |

|               |  |
|---------------|--|
| 2.            |  |
| 3.            |  |
| 4.            |  |
| 5.            |  |
|               |  |
| Web Resources |  |
| 1.            |  |
| 2.            |  |
| 3.            |  |
| 4.            |  |
| 5.            |  |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2)L-Low (1)

| Subject Code             | Subject Name                                                                                                                                                                                                                                                                                                                                                                                          | Category | L | T | P | S | Credits | Inst. Hours    | Marks             |          |       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|----------------|-------------------|----------|-------|
|                          |                                                                                                                                                                                                                                                                                                                                                                                                       |          |   |   |   |   |         |                | CIA               | External | Total |
| 23UGESO05                | <b>GEO-HERITAGE AND GEO-TOURISM</b>                                                                                                                                                                                                                                                                                                                                                                   | SEC      | - | Y | - | - | 2       | 2              | 25                | 75       | 100   |
| <b>Course Objectives</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |          |   |   |   |   |         |                |                   |          |       |
| CO1                      | To understand the importance of Geological Heritage.                                                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         |                |                   |          |       |
| CO2                      | To know about the location of geological sites                                                                                                                                                                                                                                                                                                                                                        |          |   |   |   |   |         |                |                   |          |       |
| CO3                      | To know the geo-tourisms in India.                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |                |                   |          |       |
| CO4                      | To understand the importance of field visits to geological sites.                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |         |                |                   |          |       |
| CO5                      | To know the both geological and geomorphological heritage in India.                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         |                |                   |          |       |
| UNIT                     | Details                                                                                                                                                                                                                                                                                                                                                                                               |          |   |   |   |   |         | No. of Hours   | Course Objectives |          |       |
| <b>UNIT I</b>            | Introduction to Heritage - Geodiversity- Geoheritage. Definition and introduction to Geotourism. Geo conservation. Importance of studying Geological heritage. Geo heritage site -meaning, distribution in Tamil Nadu.                                                                                                                                                                                |          |   |   |   |   |         | <b>3h/week</b> | CO1               |          |       |
| <b>UNIT II</b>           | Geoheritage sites in Tamil Nadu- detailed study on their location, Geology, conservation and important features- Fossil wood near Tiruvakkarai, National fossil wood park Sattanur, Charnockite St. Thomas Mount, Badlands of Karai- Kulakkalnatham.                                                                                                                                                  |          |   |   |   |   |         | <b>3h/week</b> | CO2               |          |       |
| <b>UNIT III</b>          | Geoheritage sites in South India- detailed study on their location, Geology conservation and their important features- Peninsular gneiss, Lalbagh Botanical Garden; Columnar Basalt, Coconut Island; Pillow lavas, Chitradurga District; Pyroclastic rocks Kolardistrict. Varkala cliff section, Thiruvananthapuram; Volcano genetically bedded barytes, Cuddapah; Eparchaeon unconformity, Chittoor; |          |   |   |   |   |         | <b>3h/week</b> | CO3               |          |       |
| <b>UNIT IV</b>           | Geoheritage sites in other than South India- detailed study on their location, Geology,                                                                                                                                                                                                                                                                                                               |          |   |   |   |   |         | <b>3h/week</b> | CO4               |          |       |

|               |                                                                                                                                                                                                                 |                |            |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|
|               | Conservation and their important features- Stroma to lite Fossil park, Jamarkotra; Wood Park, Jaisalmer; Plant fossil-bearing inter- trappean beds of Rajmahal Formation; Lonar Lake, Buldana Dist.Maharashtra. |                |            |
| <b>UNIT V</b> | Recognition of Geological and Geomorphological heritage in India. Importance of Geology and geography in tourism, natural and climatic regions of India. Important places of attraction for geological sites.   | <b>3h/week</b> | <b>CO5</b> |

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.

The blooms taxonomy verbs will be given as a separate annexure for your reference.

Each course outcome should be mapped with the POs.

The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes          | On completion of this course, students will;                                                     |               |
|--------------------------|--------------------------------------------------------------------------------------------------|---------------|
| <b>CO1</b>               | Students gain knowledge of the geological importance of the various places.                      | PO1           |
| <b>CO2</b>               | Students understand geoheritage and geotourism concepts.                                         | PO1, PO2      |
| <b>CO3</b>               | Students understand the importance of field visits to geological monuments.                      | PO4, PO6      |
| <b>CO4</b>               | They can know ideas about fossil wood and rock types.                                            | PO4, PO5, PO6 |
| <b>CO5</b>               | Students understand the importance of geology and geography in tourism.                          | PO3, PO8      |
| <b>Text Books</b>        |                                                                                                  |               |
| <b>(Latest Editions)</b> |                                                                                                  |               |
| 1.                       | Geological world heritage: A global framework- Paul Dingwall, Tony Weighell and Tim Badman(2005) |               |

|                                                                                                               |                                                                                                           |
|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 2.                                                                                                            | Amonographon National Geo heritage monuments of India(2016)- INTACH, Natural Heritage division, NewDelhi. |
| <b>References Books</b><br><b>(Latest editions, and the style as given below must be strictly adhered to)</b> |                                                                                                           |
| 1.                                                                                                            | <a href="#">Tourism Geography (1998) Philip. G. National Publisher</a>                                    |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

**Mapping with Programme Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| CO1 | 1   | 1   | 2   | 2   | 3   |
| CO2 | 2   | 3   | 3   | 2   | 2   |
| CO3 | 1   | 2   | 2   | 3   | 3   |
| CO4 | 2   | 3   | 2   | 3   | 2   |
| CO5 | 1   | 2   | 3   | 2   | 3   |

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT07         | STRATIGRAPHY                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Core     | Y | - | - | - | 4       | 5            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basic of Historical Geology                                                                                                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Know the Important group of Stratigraphic systems                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know various economic importance of various periods                                                                                                                                                                                                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the various rocks of different periods from the formation of Earth                                                                                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Present is the Key to the Past – Critical Analyse                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | General Stratigraphy: Principles of Stratigraphy, – Time units – Time rock units – Standard Geological Time scale. INDIAN STRATIGRAPHY: ARCHAEOAN: DharwarSupergroup – Champian Gneiss – Peninsular Gneiss – Closepet Granite- Sakoli Series – Saucer Series – Bundelkhand Gneiss – Banded gneissic complex – AravalliSupergroup – Raiolo Series - Singhbhum Iron ore Series – Singhbhum copper belt shear zone – Newer Dolerite – Mineral riches of Archaean. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | PROTEROZOIC: CuddapahSupergroup – Kaladgi series – Delhi Supergroup – Erinpura Granite – Malani Igneous suite – Hazara slates – Attock slates – Dogra Slates – Mineral riches of Cuddapah–VindyanSupergroup – Kurnool Supergroup – Bhima Series – Mineral riches of Vindhyan.                                                                                                                                                                                  |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | PALAEOZOIC: Cambrian of Salt range – Age of Saline series – Haimanta System – MuthQuartzites – Kanawar System – FenestellaShales – Kuling System – Everest Limestone – Panjal Volcanic Series. GondwanaSupergroup – Climate and Sedimentation – Classification – Lithology – Fossil contents – Distribution of Coal Deposits.                                                                                                                                  |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | MESOZOIC: Triassic of Spiti – Succession and fossil contents Jurassic of Kutch – Succession and fossil content – Cretaceous of Tiruchirapalli and                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                               |               |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Baghbeds.CENOZOIC: Deccan traps – Age – Distribution – Petrology – Lametabeds – Infratrappean and Intertrappean beds                                                                                          |               |     |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Tertiary of Assam and TamilnaduSiwalikSupergroup – Varkala and Quilon beds of Kerala – Tertiary of Cambay a Karewa formation – Rise of Himalayas- Pleistocene Glaciation – Indo-Gangetic alluvium – Laterite. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                                         | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                                               |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                               |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                                                                                                  |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basic of Historical Geology                                                                                                                                                                    | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the Important group of Stratigraphic systems                                                                                                                                                             | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know various economic importance of various periods                                                                                                                                                           | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the various rocks of different periods from the formation of Earth                                                                                                                                 | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Present is the Key to the Past – Critical Analyse                                                                                                                                                             | PO3, PO8      |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                               |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology of India and BurmaM.S. Krishnan, (2010), 6 <sup>th</sup> Edi., C.B.S publishers and Distributors, Delhi                                                                                               |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology of India, D.N. Wadia, (1966), McMillan company, London                                                                                                                                                |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Vaidyanadhan.R&M.Ramakrishnan, Geology of India. Geological Society of India. Bangalore(2008)                                                                                                                 |               |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | MehdirattaR.C,Geology of India, Pakisthan, Bangladesh and Burma. Atma Ram &Sons.Delhi(1974)                                                                                                                   |               |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology& Mineral Resources of the States of India. Misc Pub.No.30.Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal) GSI(2005).                                 |               |     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                               |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Fundamentals of Historical Geology and Stratigraphy of India, Ravindrakumar (1985), Wiley Eastern ltd, New Delhi.                                                                                             |               |     |

|               |                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------|
| 2.            | Principle of Stratigraphy, Dunbar and Rogers, (1964), John Wiley and co, New York               |
| 3.            | An Introduction in Stratigraphy, Stamp L.D, (1964), Thomas Murby, Museum St, WCI, London.       |
| 4.            | Stratigraphic Principles and Practices, Weller, J.M, (1962), Harper & Bros, New York            |
| 5.            | Kumar R, Fundamentals of Historical Geology and Stratigraphy of India, Wiley. New Delhi (1988). |
| Web Resources |                                                                                                 |
| 1.            | <a href="https://stratigraphy.org/">https://stratigraphy.org/</a>                               |
| 2.            | <a href="https://www.sepm.org/">https://www.sepm.org/</a>                                       |
| 3.            | <a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>                         |
| 4.            | <a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a>                                 |
| 5.            | <a href="https://isegindia.org/">https://isegindia.org/</a>                                     |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                 | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT08         | MINERALOGY                                                                                                                                                                                                                                                                                                                                                                                                                                   | Core     | Y | - | - | - | 4       | 5            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| C01               | Understand the basics of Minerals                                                                                                                                                                                                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| C02               | Understand the importance of Minerals in Geological studies                                                                                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| C03               | Know different group of minerals systems                                                                                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |         |              |                   |          |       |
| C04               | Understand the descriptive mineralogy of different groups                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| C05               | Understand the importance of Minerals and mineralogical studies                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Definition of mineral – General principles of chemistry as applied to minerals. Atoms, Molecules, Atomic Number, Valence, Ionic Radii, Coordinating Number, Bonding – Isomorphism, Polymorphism, Pseudomorphism. Physical properties of minerals depending upon Cohesion and Elasticity, Specific Gravity, Light, Heat, Electricity, Magnetism and of the Senses.                                                                            |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Nature of light – ordinary and polarized light – monochromatic light – Refraction and Reflection – Refractive Index – Critical Angle and Total reflection – Single refraction - Double refraction – Nicol Prism. Petrological Microscope and its parts – Behavior of light in its passage through a petrological microscope – Uses of quartz wedge, gypsum plate and mica plate - Classification of minerals into Isotropic and Anisotropic. |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Uniaxial and Biaxial minerals – Uniaxial and Biaxial indicatrices – Dichroism and Pleochroism – Types of Extinction – straight or parallel, symmetrical and inclined – Extinction angle – Determination of extinction angle - A brief account of Silicate structure                                                                                                                                                                          |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Descriptive mineralogy of the following essential rock forming minerals:- Quartz and its varieties – Families of Feldspar and Feldspathoids - Olivine and Garnet groups-Epidote, Beryl & Tourmaline                                                                                                                                                                                                                                          |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                 | Descriptive mineralogy of the following rock forming                                                                                                                                                                                                                                                                                                                                                                                         |          |   |   |   |   |         | 12           | CO5               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                               |               |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | mineral groups: - Amphibole and Pyroxene. Mica and Chlorite groups – Serpentine – Kaolin- Talc and Steatite - . Zircon – Sphene – Topaz – Andalusite – Sillimanite – Kyanite – Staurolite - Rutile – Calcite – Dolomite – Apatite – Fluorite. |               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total                                                                                                                                                                                                                                         | 60            |  |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                               |               |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | On completion of this course, students will;                                                                                                                                                                                                  |               |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the basics of Minerals                                                                                                                                                                                                             | PO1           |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the importance of Minerals in Geological studies                                                                                                                                                                                   | PO1, PO2      |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Know different group of minerals systems                                                                                                                                                                                                      | PO4, PO6      |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the descriptive mineralogy of different groups                                                                                                                                                                                     | PO4, PO5, PO6 |  |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the importance of Minerals and mineralogical studies                                                                                                                                                                               | PO3, PO8      |  |
| Text Books(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                               |               |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A Text book of Mineralogy , E.S. Dana, (2000) CBS Publishers & Distributors, New Delhi.                                                                                                                                                       |               |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Rutley's Elements of Mineralogy, C.D. Gribble, (1991), CBS Publishers and Distributors, New Delhi.                                                                                                                                            |               |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Wenk,H.R&A. Bulakh, Minerals, Cambridge University Press,New Delhi(2006)                                                                                                                                                                      |               |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Perkins D, 3rd ed. Prentice Hall India, NewDelhi(2010)                                                                                                                                                                                        |               |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | HaIdar,S.K.&J.Tisjlar, Introduction to Mineralogy and Petrology, Elsevier,(2014)                                                                                                                                                              |               |  |
| References Books                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                               |               |  |
| (Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                               |               |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Dana's Manual of Mineralogy, C. Hurlbut, John Wiley & Sons, New York                                                                                                                                                                          |               |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Optical Mineralogy, P.F. Kerr, (1959), McGraw Hill Book company, New York.                                                                                                                                                                    |               |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An Introduction to Rock forming Minerals, Deer, Howie and Hussmann, (1982), 2 <sup>nd</sup> Edit., Orient Longman, London.                                                                                                                    |               |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Deer,W.A.,R.A.Howie&J.Zussman. An Introduction to the Rock-Forming Minerals. ELBS.London(1992)                                                                                                                                                |               |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Berry L.G.,B.Mason&R.V. Dietrich, Mineralogy, CBS New Delhi (1985).                                                                                                                                                                           |               |  |

| Web Resources |                                                                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.            | <a href="https://en.m.wikipedia.org/wiki/mineral">https://en.m.wikipedia.org/wiki/mineral</a>                                                   |
| 2.            | <a href="https://britannica.com/science/chlorite-mineral">https://britannica.com/science/chlorite-mineral</a>                                   |
| 3.            | <a href="https://mineralseducationcoalition.org/minerals-database/zeolite">https://mineralseducationcoalition.org/minerals-database/zeolite</a> |
| 4.            | <a href="https://www.britannica.com/science/epidote">https://www.britannica.com/science/epidote</a>                                             |
| 5.            | <a href="https://www.abracom.es">https://www.abracom.es</a>                                                                                     |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2)L-Low (1)

| Subject Code                                                                                                                                                                                                                                                                                                                                               | Subject Name                                                                                                                                                                                                                                                    | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT09                                                                                                                                                                                                                                                                                                                                                  | IGNEOUS PETROLOGY                                                                                                                                                                                                                                               | Core     | Y | - | - | - | 4       | 5            | 25                | 75       | 100   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO1                                                                                                                                                                                                                                                                                                                                                        | Understand the basic Petrology                                                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO2                                                                                                                                                                                                                                                                                                                                                        | Know the textures and micro-structures                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO3                                                                                                                                                                                                                                                                                                                                                        | Know composition of magma and various system of rock formation                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO4                                                                                                                                                                                                                                                                                                                                                        | Understand the Petrographical characters of rocks                                                                                                                                                                                                               |          |   |   |   |   |         |              |                   |          |       |
| CO5                                                                                                                                                                                                                                                                                                                                                        | Analyse Origin of various rock types                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| UNIT                                                                                                                                                                                                                                                                                                                                                       | Details                                                                                                                                                                                                                                                         |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                                                                                                                                                                                                                                                                                                                                                          | UNIT I<br>Rocks – Classification into Igneous, Sedimentary and Metamorphic groups. Distribution of elements in the crust – Divisions of igneous rocks as plutonic, hypabyssal and volcanic – Intrusive and extrusive forms – Structures.                        |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                                                                                                                                                                                                                                                                                                                                                         | Textures and Microstructures – Classification of Igneous rocks (Tyrell and Streikeisen).chemical classification, CIPW classification, Tabular classification                                                                                                    |          |   |   |   |   |         | 12           | CO2               |          |       |
| III                                                                                                                                                                                                                                                                                                                                                        | Composition and constitution of magma – Study of unicomponent magma – Binary system: Diopside and Anorthite, Albite and Anorthite, and Forsterite and Silica systems – Ternary System represented by Albite – Anorthite – Diopside – Bowen’s reaction principle |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                                                                                                                                                                                                                                                                                                                                                         | Petrographic characters of Granites, Diorites, Syenites, Gabbros, Dolerite, Basalt, Pegmatites, Aplites and Lamprophyres.                                                                                                                                       |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                                                                                                                                                                                                                                                                                                                                                          | Origin of igneous rocks - Differentiation – Assimilation, - Petrography of special rock types, Anorthosite and Carbonatites.                                                                                                                                    |          |   |   |   |   |         | 12           | CO5               |          |       |
|                                                                                                                                                                                                                                                                                                                                                            | Total                                                                                                                                                                                                                                                           |          |   |   |   |   |         | 60           |                   |          |       |
| The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. The blooms taxonomy verbs will be given as a separate annexure for your reference. |                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |

Each course outcome should be mapped with the POs.  
The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes | On completion of this course, students will;                   |               |
|-----------------|----------------------------------------------------------------|---------------|
| CO1             | Understand the basic Petrology                                 | PO1           |
| CO2             | Know the textures and micro-structures                         | PO1, PO2      |
| CO3             | Know composition of magma and various system of rock formation | PO4, PO6      |
| CO4             | Understand the Petrographical characters of rocks              | PO4, PO5, PO6 |
| CO5             | Analyse Origin of various rock types                           | PO3, PO8      |

#### Text Books

(Latest Editions)

|    |                                                                                           |
|----|-------------------------------------------------------------------------------------------|
| 1. | Best, M.G., Igneous and Metamorphic Petrology, Wiley, New Delhi (2003)                    |
| 2. | McBirney A.R., Igneous Petrology, CBS New Delhi (1993)                                    |
| 3. | Best M.G., Igneous Petrology, Wiley, New Delhi (2005)                                     |
| 4. | Hatch, F.H. et al., Petrology of the Igneous Rocks, CBS Delhi.                            |
| 5. | Hyndman D.W., Petrology of the Igneous and Metamorphic Rocks McGraw Hill, New York (1985) |

#### References Books

(Latest editions, and the style as given below must be strictly adhered to)

|    |                                                                                 |
|----|---------------------------------------------------------------------------------|
| 1. | Tyrell, G.W., Principles of Petrology, B.I. Publications New Delhi (1958)       |
| 2. | Haung, W.T., Petrology, McGraw Hill, New York (1962)                            |
| 3. | Winter, J.D., Principles of Igneous and Metamorphic Petrology, PHI, New         |
| 4. | Middlemost E.A.K., Magmas and Magmatic Rocks, Longman UK (1985)                 |
| 5. | Winkler, H.G.F., Petrology of the Metamorphic Rocks, Springer, New Delhi (1970) |

#### Web Resources

|    |                                                                                                                                                                                     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | <a href="https://minerva.union.edu/hollochk/c-petrology/resources.html">https://minerva.union.edu/hollochk/c-petrology/resources.html</a>                                           |
| 2. | <a href="https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html">https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html</a>                                             |
| 3. | <a href="https://geology.com/rocks/igneous-rocks.shtml">https://geology.com/rocks/igneous-rocks.shtml</a>                                                                           |
| 4. | <a href="https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/">https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/</a> |
| 5. | <a href="https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html">https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html</a>                       |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level

| Subject Code                                                                                                                                                                                       | Subject Name                                                                                                                                                                                                           | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                                                                                                                                                                                                    |                                                                                                                                                                                                                        |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT10                                                                                                                                                                                          | SEDIMENTARY AND METAMORPHIC PETROLOGY                                                                                                                                                                                  | Core     | Y | - | - | - | 4       | 5            | 25                | 75       | 100   |
| Course Objectives                                                                                                                                                                                  |                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO1                                                                                                                                                                                                | Understand the basic Petrology                                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| CO2                                                                                                                                                                                                | Know the macro and micro-structures                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO3                                                                                                                                                                                                | Know various agents of sedimentary and metamorphic petrology                                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO4                                                                                                                                                                                                | Understand the Petrographical characters of rocks                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO5                                                                                                                                                                                                | Analyse Origin of various rock types                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| UNIT                                                                                                                                                                                               | Details                                                                                                                                                                                                                |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                                                                                                                                                                                                  | Classification (Tyrrel and Pettijohn) – Structures – Descriptive Petrography of Residual sediments.                                                                                                                    |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                                                                                                                                                                                                 | Descriptive Petrography of clastic - Arenaceous, Argillaceous and Rudaceous - Chemical and Organic deposits.                                                                                                           |          |   |   |   |   |         | 12           | CO2               |          |       |
| III                                                                                                                                                                                                | Definition – Agents and kinds of metamorphism – structure and textures – Depth zones – A brief study of Facies and grades.                                                                                             |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                                                                                                                                                                                                 | Cataclastic metamorphism and its products, thermal and dynamothermal metamorphism on Quartzofelspathic, argillaceous, calcareous and basic igneous rocks.                                                              |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                                                                                                                                                                                                  | Plutonic metamorphism on Quartzofelspathic, argillaceous, calcareous and basic igneous rocks – Charnockites – Metasomatism – A brief account of migmatites – Anatexis and palingenesis and retrogressive metamorphism. |          |   |   |   |   |         | 12           | CO5               |          |       |
|                                                                                                                                                                                                    | Total                                                                                                                                                                                                                  |          |   |   |   |   |         | 60           |                   |          |       |
| The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. |                                                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |

There will be equal number of Course objectives and Course outcomes.  
 The blooms taxonomy verbs will be given as a separate annexure for your reference.  
 Each course outcome should be mapped with the POs.  
 The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes | On completion of this course, students will;                 |               |
|-----------------|--------------------------------------------------------------|---------------|
| CO1             | Understand the basic Petrology                               | PO1           |
| CO2             | Know the macro and micro-structures                          | PO1, PO2      |
| CO3             | Know various agents of sedimentary and metamorphic petrology | PO4, PO6      |
| CO4             | Understand the Petrographical characters of rocks            | PO4, PO5, PO6 |
| CO5             | Analyse Origin of various rock types                         | PO3, PO8      |

#### Text Books

(Latest Editions)

|    |                                                                                                               |
|----|---------------------------------------------------------------------------------------------------------------|
| 1. | Principles of Petrology , G.W. Tyrrel, (1985), C.B.S Publishers and Distributors, Delhi                       |
| 2. | Petrology for sediments, S.R. Nockolds, R.W.O.Knott& G.A Chinner, (1979), Cambridge University Press, London. |
| 3. | Green smith J.T, Petrology of the Sedimentary Rocks, CBS.Delhi(1976).                                         |
| 4. | Williams,H. et al, Petrography, CBS.New Delhi(1982)                                                           |
| 5. | Haung,W.T, Petrology,McGraw Hill. New York(1962)                                                              |

#### References Books

(Latest editions, and the style as given below must be strictly adhered to)

|    |                                                                                                |
|----|------------------------------------------------------------------------------------------------|
| 1. | Metamorphism, B. Baskar Rao, (1986), Oxford I.B.D., New Delhi.                                 |
| 2. | Petrography, H.William, F.J. Turner & C.M. Gilbert, (1954) San Francisco.                      |
| 3. | Introduction to Sedimentology, Sengupta.S.M, (2007), CBS Publishers & Distributors, New Delhi. |
| 4. | TyreII,G.W,Principles of Petrology, B.I.Publications. NewDelhi(1958)                           |
| 5. | Folk,R.L, Petrology of the Sedimentary Rocks. Hemphill.Texas.USA(1974)                         |

#### Web Resources

|    |                                                                                                                                                 |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | <a href="https://www.britannica.com/science/geology/sedimentary-petrology">https://www.britannica.com/science/geology/sedimentary-petrology</a> |
| 2. | <a href="https://limk.springer.com/chapter/10">https://limk.springer.com/chapter/10</a>                                                         |
| 3. | <a href="https://www.geo.mtu.edu/UPSeis/hazards.html">https://www.geo.mtu.edu/UPSeis/hazards.html</a>                                           |
| 4. | <a href="https://www.omafra.gov.on.ca/english/engineer/facts/">https://www.omafra.gov.on.ca/english/engineer/facts/</a>                         |
| 5. | <a href="https://geology.com/rocks/rock-salt.shtml">https://geology.com/rocks/rock-salt.shtml</a>                                               |

- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                    | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UG EEM01        | Hydrogeology                                                                                                                                                                                                                                                                                    | Elective | Y | - | - | - | 3       | 4            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics components of Structural Geology                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Know the formations of geological formations                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Basics of Aerial Photographs                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the Application of Satellite science                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Analyse various physiographical features through GIS                                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                         |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Origin of Water- Water resources – Categorization of water resources - Surface water resources from Dams and Lakes.<br>Hydrologic cycle – Various components of hydrological cycle – Precipitation, Run-off, Infiltration, Evaporation and transportation - Rain gauges and their distribution. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Groundwater occurrence and movement – Aquifers –                                                                                                                                                                                                                                                |          |   |   |   |   |         | 12           | CO2               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Definition and Different types of aquifer – Spring and its types. Hydrogeological Properties of rocks .Basic Principles of groundwater exploration.                                                                                                                                                                                                                                                                          |     |     |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Rock properties affecting groundwater. Types of Openings, Porosity, Specific yield, Specific retention and Permeability. Determination of permeability in field and lab. Groundwater movement – Darcy's law and its applications – Groundwater occurrence in Igneous, Sedimentary and Metamorphic rocks.                                                                                                                     | 12  | CO3 |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Groundwater investigation-Electrical Resistivity Methods: Wenner's and Schlumberger's electrode arrangements. Wells and their types, Basic concept, Ground water potential of India and Tamil Nadu. Well design and development-Fluctuations of groundwater - Groundwater recharge methods. Suitability for drinking and irrigation purposes - Seawater intrusion: Causes, Consequences and Preventive and Control measures. | 12  | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Running water – source – weathering, erosion, transportation and deposition – process and its features – Water Shed Management. Rainwater harvesting – Definition, method and their importance                                                                                                                                                                                                                               | 12  | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Total                                                                                                                                                                                                                                                                                                                                                                                                                        | 60  |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | On completion of this course, students will;                                                                                                                                                                                                                                                                                                                                                                                 |     |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Understand the basics components of Structural                                                                                                                                                                                                                                                                                                                                                                               | PO1 |     |

|                                                                                                 |                                                                                              |               |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------|
|                                                                                                 | Geology                                                                                      |               |
| C02                                                                                             | Know the formations of geological formations                                                 | PO1, PO2      |
| C03                                                                                             | Basics of Aerial Photographs                                                                 | PO4, PO6      |
| C04                                                                                             | Understand the Application of Satellite science                                              | PO4, PO5, PO6 |
| C05                                                                                             | Analyse various physiographical features through GIS                                         | PO3, PO8      |
| Text Books<br>(Latest Editions)                                                                 |                                                                                              |               |
| 1.                                                                                              | Alley.W.M. 1993. Regional groundwater quality – VNR- New York.                               |               |
| 2.                                                                                              | Arul P. 2000 A text book of Ground water, 1st Edition, 105 – 122                             |               |
| 3.                                                                                              | Bouwer, H., 1978, Groundwater Hydrology, McGraw-Hill Book co., NY                            |               |
| 4.                                                                                              | Bell, F.G. (2005), Fundamentals of Engineering Geology, B.S. Publications Hyderabad.         |               |
| 5.                                                                                              | Krynine, P.D.& W.R. Judd (1956), Principles of Engineering Geology & Geotechnics, CBS, Delhi |               |
| 6.                                                                                              | Legget, R.F.& A.W. Hatheway (1988), Geology and Engineering. 3rd Ed. McGraw Hill, New York.  |               |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                              |               |
| 1.                                                                                              | Davies, S.N., & Dewilest, R.J.M., 1966, Hydrogeology, John Wiley & Sons Inc., N              |               |
| 2.                                                                                              | Fetter.C.W. 1990. Applied Hydrology. Merrill Publishing.                                     |               |
| 3.                                                                                              | Karantk.R.R. 1987. Groundwater assessments and management – Tata Mc-graw Hall                |               |
| 4.                                                                                              | M. Raghunath 2007 Ground Water, New Age International , 520p                                 |               |
| 5.                                                                                              |                                                                                              |               |
| Web Resources                                                                                   |                                                                                              |               |
| 1.                                                                                              |                                                                                              |               |
| 2.                                                                                              |                                                                                              |               |
| 3.                                                                                              |                                                                                              |               |
| 4.                                                                                              |                                                                                              |               |
| 5.                                                                                              |                                                                                              |               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                         | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                      |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGEEM02         | REMOTE SENSING AND GIS                                                                                                                                                                                                               | Elective | Y | - | - | - | 3       | 4            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO1               | To impart knowledge and applications of remote sensing and GIS in Geology                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| CO2               | To learn basic of aerial remote sensing and its applications.                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO3               | To understand the physics of electromagnetic spectrum and learn satellite remote sensing.                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| CO4               | To have training in GIS components, models and applications                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| CO5               |                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                              |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Definition and Types: Aerial, Satellite and Radar, Development of Space Programmes - History and Organization Associated with Remote Sensing in India and in other Countries.                                                        |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Remote Sensing: Sources of Energy, Electromagnetic Radiations (EMR) Atmospheric Windows, Energy Interaction with Atmosphere and Earth. Types of Platforms: Active and Passive. Remote Sensing Methods, Ideal Remote Sensing Systems. |          |   |   |   |   |         | 12           | CO2               |          |       |

|     |                                                                                                                                                                                                                                          |    |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|
|     |                                                                                                                                                                                                                                          |    |     |
| III | Fundamentals of Aerial Remote Sensing: Components of Aerial Camera, Types of Aerial Photographs, Marginal Information of Aerial Photographs, Elements of Photo Interpretation.                                                           | 12 | CO3 |
| IV  | Fundamentals of Satellite Remote Sensing: Types of Satellites: Geo-Stationary and Sun-Synchronous Satellites, Resolution: Spatial, Spectral, Radiometric and Temporal, Types of Data Products, Marginal Information of Satellite Images. | 12 | CO4 |
| V   | Geographical Information Systems (GIS) Meaning- Developments-Raster and Vector Data-Data Integration-Global Positioning System (GPS) Advantages and Limitations of GIS and GPS.                                                          | 12 | CO5 |
|     | Total                                                                                                                                                                                                                                    | 60 |     |

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.

The blooms taxonomy verbs will be given as a separate annexure for your reference.

Each course outcome should be mapped with the POs.

The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes | On completion of this course, students will;                                              |               |
|-----------------|-------------------------------------------------------------------------------------------|---------------|
| CO1             | To impart knowledge and applications of remote sensing and GIS in Geology.                | PO1           |
| CO2             | To learn basic of aerial remote sensing and its applications.                             | PO1, PO2      |
| CO3             | To understand the physics of electromagnetic spectrum and learn satellite remote sensing. | PO4, PO6      |
| CO4             | Understand the Application of Satellite science                                           | PO4, PO5, PO6 |
| CO5             | Analyse various physiographical features through GIS                                      | PO3, PO8      |

#### Text Books

(Latest Editions)

|                                                                                                 |                                                                                                              |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1.                                                                                              |                                                                                                              |
| 2.                                                                                              |                                                                                                              |
| 3.                                                                                              |                                                                                                              |
| 4.                                                                                              |                                                                                                              |
| 5.                                                                                              |                                                                                                              |
| 6.                                                                                              |                                                                                                              |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                              |
| 1.                                                                                              | Curran,P.B.(1985). Principles of Remote Sensing. ELBS,London.                                                |
| 2.                                                                                              | Drury,S.D.(1993). Image Interpretation in Geology. Allen & Unwin, London.                                    |
| 3.                                                                                              | Barret, E.C. and Curtie, L.F. (1990), Introduction to Environmental Remote Sensing,Chapman and Hall, London. |
| 4.                                                                                              | Cambell, James B. (1987), Introduction to Remote Sensing, The Guilford Press, NewYork.                       |
| 5.                                                                                              | Lillesand, T. M. and Kieper (1987), Remote Sensing and Image Interpretation, JohnWillyand Sons, New York.    |
| Web Resources                                                                                   |                                                                                                              |
| 1.                                                                                              |                                                                                                              |
| 2.                                                                                              |                                                                                                              |
| 3.                                                                                              |                                                                                                              |
| 4.                                                                                              |                                                                                                              |
| 5.                                                                                              |                                                                                                              |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |

|      |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|
| CO 5 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
|------|---|---|---|---|---|---|---|---|

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Subject Name                                                                                                                                                                                                                                                                                                             | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              | CIA               | External | Total |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Internship /<br>Industrial Visit / Field Visit                                                                                                                                                                                                                                                                           |          | Y | - | - | - | 2       | -            | 25                | 75       | 100   |  |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The students will enhance their writing skills.                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | They will acquire knowledge about writing their assignments.                                                                                                                                                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | They will delve into uncharted territory with regard to Scientific/Technical writing of research papers/reports.                                                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The students will understand what is Bibliography, how to cite references and how to quote them in the text.                                                                                                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |  |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report.                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |  |
| UNIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Details                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |  |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Students will be taken to various mines and mineral exploration industries across the country to gain first hand field experience on various mining methods, R&D activities in mineral exploration, interaction with subject experts in various industries and organizations involved in mineral exploration activities. |          |   |   |   |   |         | 12           | CO1               |          |       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Total                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |  |
| The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. The blooms taxonomy verbs will be given as a separate annexure for your reference. Each course outcome should be mapped with the POs. The mapping of each CO can be done with any number of POs. |                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                          | On completion of this course, students will;                                                                                                                                                                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The students will enhance their writing skills.                                                                                                                                                                                                                                                                          |          |   |   |   |   |         | PO1          |                   |          |       |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | They will acquire knowledge about writing their assignments.                                                                                                                                                                                                                                                             |          |   |   |   |   |         | PO1, PO2     |                   |          |       |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | They will delve into uncharted territory with regard to                                                                                                                                                                                                                                                                  |          |   |   |   |   |         | PO4, PO6     |                   |          |       |  |

|                                                                                                         |                                                                                                                                                                                     |               |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|                                                                                                         | Scientific/Technical writing of research papers/reports.                                                                                                                            |               |
| <b>CO4</b>                                                                                              | The students will understand what is Bibliography, how to cite references and how to quote them in the text.                                                                        | PO4, PO5, PO6 |
| <b>CO5</b>                                                                                              | They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report.                                              | PO3, PO8      |
| <b>Text Books<br/>(Latest Editions)</b>                                                                 |                                                                                                                                                                                     |               |
| 1.                                                                                                      | Best,M.G,Igneous and Metamorphic Petrology, Wiley.New Delhi(2003)                                                                                                                   |               |
| 2.                                                                                                      | McBirney A.R,Igneous Petrology, CBS New Delhi(1993)                                                                                                                                 |               |
| 3.                                                                                                      | Best M.G,Igneous Petrology.Wiley.New Delhi(2005)                                                                                                                                    |               |
| 4.                                                                                                      | Hatch,F.H. et al,Petrology of the Igneous Rocks, CBS Delhi.                                                                                                                         |               |
| 5.                                                                                                      | Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGrawHill.New York(1985)                                                                                               |               |
| <b>References Books<br/>(Latest editions, and the style as given below must be strictly adhered to)</b> |                                                                                                                                                                                     |               |
| 1.                                                                                                      | Tyre II, G.W, Principles of Petrology, B.I. Publications New Delhi(1958)                                                                                                            |               |
| 2.                                                                                                      | Haung, W.T, Petrology, McGrawHill. New York (1962)                                                                                                                                  |               |
| 3.                                                                                                      | Winter, J.D, Principles of Igneous and Metamorphic Petrology, PHI. New                                                                                                              |               |
| 4.                                                                                                      | Middlemost E.A.K, Magmas and Magmatic Rocks. Longman UK(1985)                                                                                                                       |               |
| 5.                                                                                                      | Winkler, H.G.F, Petrology of the Metamorphic Rocks. Springer, New Delhi(1970)                                                                                                       |               |
| <b>Web Resources</b>                                                                                    |                                                                                                                                                                                     |               |
| 1.                                                                                                      | <a href="https://minerva.union.edu/hollochkc/c-petrology/resources.html">https://minerva.union.edu/hollochkc/c-petrology/resources.html</a>                                         |               |
| 2.                                                                                                      | <a href="https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html">https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html</a>                                             |               |
| 3.                                                                                                      | <a href="https://geology.com/rocks/igneous-rocks.shtml">https://geology.com/rocks/igneous-rocks.shtml</a>                                                                           |               |
| 4.                                                                                                      | <a href="https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/">https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/</a> |               |
| 5.                                                                                                      | <a href="https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html">https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html</a>                       |               |

**In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.**

**The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.**

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

**Mapping with Programme Outcomes:**

|  |             |             |             |             |             |             |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|  | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|

|             |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|
| <b>CO 1</b> | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| <b>CO 2</b> | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| <b>CO 3</b> | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| <b>CO 4</b> | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 |
| <b>CO 5</b> | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |

**S-Strong(3)    M-Medium (2)        L-Low (1)**

#### SEMESTER - VI

| Subject Code      | Subject Name                                                                                                                                                                                                                 | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                              |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECT11         | REGIONAL GEOLOGY                                                                                                                                                                                                             | Core     | Y | - | - | - | 4       | 6            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                              |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand various Geological formations at Regional Scale                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Know the Important Stratigraphic landforms                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know various economic importance of regional geology                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Know the mode of occurrence and uses of minerals                                                                                                                                                                             |          |   |   |   |   |         |              |                   |          |       |
| CO5               | To predict mineral formations in an unknown region.                                                                                                                                                                          |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                      |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Geomorphology: Tectonic and Shear Zones of Tamil Nadu -Physiography – The Western and Eastern Ghats of Tamil Nadu and their structural aspects. The Cauvery and Tambraparani Rivers – Soil types of Tamil Nadu.              |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Archaean Group – Anorthosites of Sittampundi, Kadavur and Oddanchatram – Alkali Rocks of Sivanmalai, Cordierite Sillimanite rocks of Trichy and Madurai, Charnockites of Pallavaram-Thiruttani Dyke swarms.                  |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Gondwana Supergroup – Sriperumbudur beds and Therany clay beds - Cretaceous of Trichy District – Cenomanian Marine transgression –Tertiary group of Cauvery basins. Distribution of petroleum and natural gas in Tamil Nadu. |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Cuddalore Sandstone, Neyveli Lignite Deposits - Mode                                                                                                                                                                         |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                |               |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | of occurrence & distribution of precious and Semi - precious stones in Tamil Nadu. Distribution of commercial granites, Heavy mineral sands (Zircon, Rutile, Ilmenite and Garnet ) and Thorium deposits of Manavalakurichi in Tamil Nadu.                                                                                                                                      |               |     |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Mode of occurrence, uses, origin, and distribution in Tamil Nadu of the followings mineral deposit: Iron ores of Kanjamalai, Gauthimalai; Magnesite deposits of Chalk hills; Bauxite deposits of Shaveroy hill; Graphite beds of Sivaganga- Silica Sands of coastal areas in Kanchipuram, Thiruvallur, Cuddalore and Nagapattinam districts- River sand deposits of TamilNadu. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                                                                                                                                                                                                          | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                                                                                                                                                                                                                |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                                                                                                                                                                                                                                                                   |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basic of Historical Geology                                                                                                                                                                                                                                                                                                                                     | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the Important group of Stratigraphic systems                                                                                                                                                                                                                                                                                                                              | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know various economic importance of various periods                                                                                                                                                                                                                                                                                                                            | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the various rocks of different periods from the formation of Earth                                                                                                                                                                                                                                                                                                  | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Present is the Key to the Past – Critical Analyse                                                                                                                                                                                                                                                                                                                              | PO3, PO8      |     |
| Text Books(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology of India and BurmaM.S. Krishnan, (2010), 6 <sup>th</sup> Edi., C.B.S publishers and Distributors, Delhi                                                                                                                                                                                                                                                                |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology of India, D.N. Wadia, (1966), McMillan company, London                                                                                                                                                                                                                                                                                                                 |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Vaidyanadhan.R&M.Ramakrishnan, Geology of India. Geological Society of India. Bangalore(2008)                                                                                                                                                                                                                                                                                  |               |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Geology& Mineral Resources of the States of India. Misc Pub.No.30.Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal) GSI(2005).                                                                                                                                                                                                  |               |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Kumar R,Fundamentals of Historical Geology and Stratigraphy of                                                                                                                                                                                                                                                                                                                 |               |     |

|                                                                                                 |                                                                                                                   |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
|                                                                                                 | India,Wiley.New Delhi (1988).                                                                                     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                   |
| 1.                                                                                              | Fundamentals of Historical Geology and Stratigraphy of India, Ravindrakumar (1985), Wiley Eastern ltd, New Delhi. |
| 2.                                                                                              | Principle of Stratigraphy, Dunbar and Roggers, (1964), John Wiley and co, New York                                |
| 3.                                                                                              | An Introduction in Stratigraphy, Stamp L.D, (1964), Thomas Murby, Museum St, WCI, London.                         |
| 4.                                                                                              | Stratigraphic Principles and Practices, Weller, J.M, (1962), Harper & Bros, New York                              |
| 5.                                                                                              | Wadia,D.N, Geology of India, McMillan India Delhi(1953)                                                           |
| Web Resources                                                                                   |                                                                                                                   |
| 1.                                                                                              | <a href="https://stratigraphy.org/">https://stratigraphy.org/</a>                                                 |
| 2.                                                                                              | <a href="https://www.sepm.org/">https://www.sepm.org/</a>                                                         |
| 3.                                                                                              | <a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>                                           |
| 4.                                                                                              | <a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a>                                                   |
| 5.                                                                                              | <a href="https://isegindia.org/">https://isegindia.org/</a>                                                       |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Category | L | T | P | S | ed | Li           | Ho | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|----|--------------|----|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |    |              |    | CIA               | External | Total |
| 23UGECT12         | ECONOMIC GEOLOGY AND MINERAL ECONOMICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Core     | Y | - | - | - | 4  | 6            |    | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |    |              |    |                   |          |       |
| C01               | Understand basics of Economic minerals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |    |              |    |                   |          |       |
| C02               | Know the various process of mineral formation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |   |   |   |   |    |              |    |                   |          |       |
| C03               | Know the various mode of mineral deposits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |    |              |    |                   |          |       |
| C04               | Know the physical and chemical characters of minerals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   |   |    |              |    |                   |          |       |
| C05               | To understand various uses of minerals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |    |              |    |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |   |   |   |   |    | No. of Hours |    | Course Objectives |          |       |
| I                 | Definition of ore, tenor, grade and metallic and non-metallic minerals.Geologic thermometry -- Classification of ore deposits, (Lindgren and Bateman).Process of mineral formations - magmatic concentration - sublimation, contact metasomatism-Hydrothermal process - sedimentation - evaporation.                                                                                                                                                                                                                                                                               |          |   |   |   |   |    | 12           |    | CO1               |          |       |
| II                | Processes of mineral formation: Residual and mechanical concentration - Oxidation and supergene sulphide enrichment - metamorphism. Coal deposits: Use, origin, Mode of Occurrence, distribution in India.Petroleum deposits: Origin and distribution in India.- Mineralogy, origin, mode of occurrence, uses and distribution in India of the following: - Gold Deposits, Iron deposits, and copper deposits.                                                                                                                                                                     |          |   |   |   |   |    | 12           |    | CO2               |          |       |
| III               | Mineralogy, origin, mode of occurrence, uses and distribution in India of the following: - manganese deposits, lead and zinc deposits, bauxite deposits and chromite deposits. Granite Industry I: Building stones - properties - cost, color, durability, crushing strength, transverse strength, absorption, density, frost and fire resistance, structural features, texture.Important building stones, physical and chemical properties and uses of granite, marble, limestone, sandstone, slate.Classification of commercial granites in pre-cambrian terrain of south India. |          |   |   |   |   |    | 12           |    | CO3               |          |       |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                   |    |     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|
| IV | Physical properties, chemical composition, mode of occurrence and distribution in India of minerals required for the following industries: – Abrasives, fertilizers and refractory. Descriptive mineralogy, Mode of occurrence, uses, distribution in India of the following ores and industrial minerals: realgar, orpiment, cinnabar, fluorite, ilmenite, rutile, graphite, magnesite, asbestos and chrysotile. | 12 | CO4 |
| V  | Granite Industry II: Granite blocks - quarrying techniques – pre quarrying phase – operational phase – quarrying in earlier and recent times – blasting methodology – primary and secondary cutting – supporting machineries – problems encountered in granite mining. Granite trade, marketability, Resource estimation                                                                                          | 12 | CO5 |
|    | Total                                                                                                                                                                                                                                                                                                                                                                                                             | 60 |     |

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.

The blooms taxonomy verbs will be given as a separate annexure for your reference.

Each course outcome should be mapped with the POs.

The mapping of each CO can be done with any number of POs.

#### Course Outcomes

| Course Outcomes | On completion of this course, students will;                    |               |
|-----------------|-----------------------------------------------------------------|---------------|
| CO1             | Understand the basics of Minerals                               | PO1           |
| CO2             | Understand the importance of Minerals in Geological studies     | PO1, PO2      |
| CO3             | Know different group of minerals systems                        | PO4, PO6      |
| CO4             | Understand the descriptive mineralogy of different groups       | PO4, PO5, PO6 |
| CO5             | Understand the importance of Minerals and mineralogical studies | PO3, PO8      |

#### Text Books

(Latest Editions)

|    |                                                                                                   |
|----|---------------------------------------------------------------------------------------------------|
| 1. | Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi                |
| 2. | Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. & Dist, New Delhi |
| 3. | Krishnasamy S, India's Mineral Resources, Oxford & IBH. Delhi (1988)                              |
| 4. | Sharma N.L. & R.K. Sinha. Mineral Economics, Oxford & IBH. Delhi (1985)                           |
| 5. | Prasad U, Economic Mineral Deposits, CBS. Delhi (2003)                                            |

| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.                                                                                              | India's Mineral Resources, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi                                                              |
| 2.                                                                                              | Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V.,(1970), Dhanbad publications, Dhanbad.                                                                            |
| 3.                                                                                              | Industrial Minerals ,Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.                                                                                                                |
| 4.                                                                                              | Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985)                                                                                                     |
| 5.                                                                                              | Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy, Madras, (1964).                                                                                              |
| Web Resources                                                                                   |                                                                                                                                                                                         |
| 1.                                                                                              | <a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>                                                                       |
| 2.                                                                                              | <a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>                                                                   |
| 3.                                                                                              | <a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>                                                   |
| 4.                                                                                              | <a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a> |
| 5.                                                                                              | <a href="https://link.spring.com/">https://link.spring.com/</a>                                                                                                                         |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Category | L | T | P | S | ed | u            | Ho | Marks             |          |       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|----|--------------|----|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |    |              |    | CIA               | External | Total |
| 23UGECT13         | APPLIED GEOLOGY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Core     | Y | - | - | - | 4  | 6            |    | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |    |              |    |                   |          |       |
| CO1               | Understand basics of Hydrological Cycle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |    |              |    |                   |          |       |
| CO2               | Know the various hydrological parameters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |    |              |    |                   |          |       |
| CO3               | Know the various water bearing formations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |    |              |    |                   |          |       |
| CO4               | Know the application of Geological methods in groundwater investigations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |    |              |    |                   |          |       |
| CO5               | To explore groundwater regime through various geophysical methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |    |              |    |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |    | No. of Hours |    | Course Objectives |          |       |
| I                 | Engineering Geology: Dams, Reservoirs and Tunnels – Brief description of the types of dam, Reservoir, spillways, Tunnels, bridges and highways. Engineering properties of Rocks: Porosity – permeability – elasticity characteristics of rocks.                                                                                                                                                                                                                                                                                                                                                             |          |   |   |   |   |    | 12           |    | CO1               |          |       |
| II                | Environmental Geology: Environmental science – Introduction; Environmental impacts due to mining and mineral process. A short account of renewable and non-renewable resources. Effects of urbanization on surface and subsurface water- causes for ground water pollution.                                                                                                                                                                                                                                                                                                                                 |          |   |   |   |   |    | 12           |    | CO2               |          |       |
| III               | Hydrologic cycle – origin of water – meteoric, juvenile, magmatic and seawaters; Hydrological parameters - Precipitation, evaporation, transpiration and infiltration. vertical distribution of ground water, Springs and its types; Porosity and permeability. specific yield, specific retention.<br>Aquifer, aquitard, aquifuge and aquiclude – Classifications of aquifers. Ground water movements – Darcy's law. Specific yield and specific retention. Water Level fluctuation and its causes. Ground water quality – Physical and chemical properties of water, quality criteria for different uses. |          |   |   |   |   |    | 12           |    | CO3               |          |       |
| IV                | Concepts of drainage basin and ground water provinces of India. A short account of ground water basins in Tamil Nadu. - Ground water exploration- Dowsing- – Brief out line of various methods of groundwater exploration.                                                                                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |    | 12           |    | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                      |               |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Geological Method – Identification of formations and structure favorable for movement and storage of groundwater water. Geophysical Methods- Surface and Subsurface methods.Electrical resistivity method – Wenner Method – Schlumberger Method.Field Data interpretation – Curve matching and inverse slope method. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                                                                                                                                                | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                                                                                                                                                      |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                      |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                                                                                                                                                                                                         |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand basics of Hydrological Cycle                                                                                                                                                                                                                                                                              | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the various hydrological parameters                                                                                                                                                                                                                                                                             | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the various water bearing formations                                                                                                                                                                                                                                                                            | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know the application of Geological methods in groundwater investigations                                                                                                                                                                                                                                             | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To explore groundwater regime through various geophysical methods                                                                                                                                                                                                                                                    | PO3, PO8      |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                      |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Outlines of Geophysical Prospecting - A manual for geologists by RamachandraRao, M.B.,Prasaranga, University of Mysore, Mysore, 1975.                                                                                                                                                                                |               |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Groundwater Hydrology, Todd.D.K. (1980) John Wiley Sons, Inc                                                                                                                                                                                                                                                         |               |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Coppola D.P, Introduction to International Disaster Management, Butterworth Heinemann(2007)                                                                                                                                                                                                                          |               |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Pine,J.C, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group(2009)                                                                                                                                                                                                      |               |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster Rout ledge Press(2001)                                                                                                                                                                                                                          |               |     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                      |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Groundwater Drilling, Handa.O.P (1984) Oxford & I.B.H. Publishing Co.                                                                                                                                                                                                                                                |               |     |

|               |                                                                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.            | Groundwater, Raghunath.H.M. (1987) 2 <sup>nd</sup> Edition, Wiley Eastern Ltd.                                                                  |
| 3.            | Groundwater Assessment Development and Management, Karanth.K.R. (1987)<br>Tata McGraw Hill Publishing Company, Ltd.                             |
| 4.            | Miller T.G. Environmental Science. Wadsworth Publishing.US(2004).                                                                               |
| 5.            | Coates,D.R. Environmental Geology. McGraw Hill.NewYork(1984)                                                                                    |
| Web Resources |                                                                                                                                                 |
| 1.            | <a href="https://www.britannica.com/science/geology/sedimentary-petrology">https://www.britannica.com/science/geology/sedimentary-petrology</a> |
| 2.            | <a href="https://link.springer.com/chapter/10">https://link.springer.com/chapter/10</a>                                                         |
| 3.            | <a href="https://www.geo.mtu.edu/UPSeis/hazards.html">https://www.geo.mtu.edu/UPSeis/hazards.html</a>                                           |
| 4.            | <a href="https://www.omafra.gov.on.ca/english/engineer/facts/">https://www.omafra.gov.on.ca/english/engineer/facts/</a>                         |
| 5.            | <a href="https://geology.com/rocks/rock-salt.shtml">https://geology.com/rocks/rock-salt.shtml</a>                                               |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECP03         | MINERALOGY<br>AND PETROLOGY PRACTICAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Core     | Y | - | - | - | 2       | 5            | 40                | 60       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basic Petrology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Know the macro and micro-structures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know various agents of sedimentary and metamorphic petrology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the Petrographical characters of rocks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Analyse Origin of various rock types                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Megascopic identification and description of the following: quartz, chalcedony, opal, agate, flint, jasper, amethyst, rose quartz, orthoclase, microcline, albite, oligoclase, labradorite, adularia, sanidine, nepheline, sodalite, lapis lazuli, hornblende, Actinolite, tremolite, enstatite, bronzite, hypersthene, augite, olivine, serpentine, muscovite, biotite, phlogopite, lepidolite, vermiculite, chlorite, epidote, garnet, apophyllite, stilbite, heulandite, talc, steatite, beryl, kaolin, cordierite, apatite, andalusite, staurolite, sillimanite, kyanite, tourmaline, topaz, calcite, dolomite and fluor spar. |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Microscopic identification and description of the following: quartz, orthoclase, albite, oligoclase, andesine, labradorite, anorthite, nepheline, leucite, sodalite, hypersthene, augite, diopside, aegirine, hornblende, tremolite, actinolite, glaucophane, riebeckite, muscovite, biotite, phlogopite, olivine, serpentine, chlorite, epidote, garnet, apatite, zircon, sphene, magnetite, tourmaline, calcite, dolomite, andalusite, staurolite, sillimanite and cordierite.                                                                                                                                                   |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Megascopic identification and description of the following rocks: granite, graphic granite, pegmatite, aplite, orbicular granite, schorl rock, tourmaline rock, granite porphyry, Syenite, dolerite, gabbro, anorthosite,                                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   |   |         | 12           | CO3               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | olivine, gabbro, dunite, pyroxenite, norite, dolerite porphyry, basalt, trachyte, rhyolite, vitrophyre, obsidian, pumice, scoria, pitchstone, volcanic tuff and volcanic breccia.                                                                                                                                                                                                                                                                                                                                                  |               |     |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Megascopic identification and description of the following: conglomerate, breccia, laterite, sandstone, arkose, greywacke, grit, shales, limestones, chert, flint, peat, bituminous coal, anthracite, lignite, chalk, gneisses, schist, phyllite, slates, quartzite, marble, ophicalcite, itabirite, jaspillite, quartz-magnetite rock, amphibolite, eclogite, leptynite, khondalite, kodurite, gondite, charnockite, calc granulite and basic granulite.                                                                          | 12            | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Microscopic identification and description of the following: mica granite, hornblende granite, tourmaline granite, schorl rock, aplite, graphic granite, quartz syenite, mica syenite, hornblende syenite, nephelinesyenite, quartz diorite, hornblende diorite, olivine gabbro, hypersthene gabbro, troctolite, dunite, peridotite granite porphyry; syenite porphyry, diorite porphyry, quartz porphyry, dolerite, minette, anorthosite, rhyolite, trachyte, andesite, basalt, leucite, phonolite, nosean, and volcanic breccia. | 12            | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 60            |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> <p>Course Outcomes</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | On completion of this course, students will;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the basic Petrology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PO1           |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Know the macro and micro-structures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | PO1, PO2      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Know various agents of sedimentary and metamorphic petrology                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PO4, PO6      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Understand the Petrographical characters of rocks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | PO4, PO5, PO6 |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Analyse Origin of various rock types                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PO3, PO8      |     |
| Text Books(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |     |

|                                                                                                 |                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                 | Delhi                                                                                                                                                                                   |
| 2.                                                                                              | Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. & Dist, New Delhi                                                                                       |
| 3.                                                                                              | Krishnasamy S, India's Mineral Resources, Oxford & IBH. Delhi (1988)                                                                                                                    |
| 4.                                                                                              | Sharma N.L. & R.K. Sinha. Mineral Economics, Oxford & IBH. Delhi (1985)                                                                                                                 |
| 5.                                                                                              | Prasad U, Economic Mineral Deposits, CBS. Delhi (2003)                                                                                                                                  |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) |                                                                                                                                                                                         |
| 1.                                                                                              | India's Mineral Resources, Krishnaswamy S revised by Shina, R.K, (1986), III Ed., Oxford & IBH Pub., Co., Ltd., New Delhi                                                               |
| 2.                                                                                              | Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V., (1970), Dhanbad publications, Dhanbad.                                                                           |
| 3.                                                                                              | Industrial Minerals, Sinha, R.K, (1986), Oxford 7 IBH Pub. Co., New Delhi.                                                                                                              |
| 4.                                                                                              | Craig, R.C. & D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York. (1985)                                                                                                 |
| 5.                                                                                              | Aiyengar, N.K.N, Minerals of Madras, Dept. of Industries & Commerce. Guindy, Madras, (1964).                                                                                            |
| Web Resources                                                                                   |                                                                                                                                                                                         |
| 1.                                                                                              | <a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>                                                                       |
| 2.                                                                                              | <a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>                                                                   |
| 3.                                                                                              | <a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>                                                   |
| 4.                                                                                              | <a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a> |
| 5.                                                                                              | <a href="https://link.spring.com/">https://link.spring.com/</a>                                                                                                                         |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                                                              | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGECP04         | ECONOMIC GEOLOGY AND ORE ANALYSIS PRACTICAL                                                                                                                                                                                                                                                                               | CO RE    | Y | - | - | - | 2       | 5            | 40                | 60       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics of Minerals                                                                                                                                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Understand the importance of Minerals in Geological studies                                                                                                                                                                                                                                                               |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know different group of minerals systems                                                                                                                                                                                                                                                                                  |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the descriptive mineralogy of different groups                                                                                                                                                                                                                                                                 |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Understand the importance of Minerals and mineralogical studies                                                                                                                                                                                                                                                           |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                                                                   |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following ores: galena, anglesite, cerrusite, sphalerite, zincite, willemite, bornite, azurite, chalcopyrite, cuprite, malachite.                                                                                   |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following ores: haematite, magnetite, siderite, goethite, pyrolusite, psilomelane, rhodochrosite, rhodonite, chromite, cinnabar, bauxite, realgar, orpiment, stibnite, molybdenite, pyrite, coal and its varieties. |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Megascopic identification and description of: monazite, samarskite, columbite, tantalite, beryl, zircon, Megascopic identification and description of the following minerals used for industrial purposes – magnesite, calcite, dolomite, gypsum, strontianite, celestite, fluorite, apatite.                             |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Megascopic identification and description of the following minerals used for industrial purposes: barite, witherite, limonite, asbestos, quartz, feldspar, kaolin, garnet, rutile and ilmenite.                                                                                                                           |          |   |   |   |   |         | 12           | CO4               |          |       |
| V                 | Identification of the following mineral powders by blowpipe methods: galena, chalcopyrite, haematite, magnetite, celestite, strontianite, witherite, gypsum, bauxite, apatite, pyrite, siderite, orpiment, realgar,                                                                                                       |          |   |   |   |   |         | 12           | CO5               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |    |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | calcite, psilomelane, rhodochrosite, smithsonite and ilmenite.                                                            |    |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                     | 60 |  |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                           |    |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |    |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                              |    |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basics of Minerals                                                                                         |    |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of Minerals in Geological studies                                                               |    |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know different group of minerals systems                                                                                  |    |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the descriptive mineralogy of different groups                                                                 |    |  |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of Minerals and mineralogical studies                                                           |    |  |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |    |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi                                        |    |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. & Dist, New Delhi                         |    |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Krishnasamy S, India's Mineral Resources, Oxford & IBH. Delhi (1988)                                                      |    |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sharma N.L & R.K. Sinha. Mineral Economics, Oxford & IBH. Delhi (1985)                                                    |    |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Prasad U, Economic Mineral Deposits, CBS. Delhi (2003)                                                                    |    |  |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |    |  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | India's Mineral Resources, Krishnaswamy S revised by Sinha, R.K, (1986), III Ed., Oxford & IBH Pub., Co., Ltd., New Delhi |    |  |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V., (1970), Dhanbad publications, Dhanbad.             |    |  |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Industrial Minerals, Sinha, R.K, (1986), Oxford & IBH Pub. Co., New Delhi.                                                |    |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Craig, R.C & D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York. (1985)                                    |    |  |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Aiyengar, N.K.N, Minerals of Madras, Dept. of Industries & Commerce. Guindy,                                              |    |  |

|               |                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | Madras, (1964).                                                                                                                                                                         |
| Web Resources |                                                                                                                                                                                         |
| 1.            | <a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>                                                                       |
| 2.            | <a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>                                                                   |
| 3.            | <a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>                                                   |
| 4.            | <a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a> |
| 5.            | <a href="https://link.spring.com/">https://link.spring.com/</a>                                                                                                                         |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2)L-Low (1)

## NON-MAJOR ELECTIVE COURSE

| Subject Code      | Subject Name                                                                                                                                                                                                                                                                       | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGEN E01        | <b>GEMOLOGY AND GEMSTONE EVALUATION</b>                                                                                                                                                                                                                                            | NM E     | Y |   |   |   | 2       | 2            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics of Gems                                                                                                                                                                                                                                                      |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Understand the importance of Gems in Geological studies                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know different group of Gemssystems                                                                                                                                                                                                                                                |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the descriptive Gemmologyof different groups                                                                                                                                                                                                                            |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Understand the importance of quality of Gems                                                                                                                                                                                                                                       |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                                                                            |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Definition and Scope of Gemology – Minerals as Gemstones – Classification of Gemstones – Characteristic and Desirable Features of Gemstones. Basic Physical and Optical properties of Gemstones– Optical Classification of Gemstones.                                              |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Gem Testing: Introduction to Gem Mineral Equipment and Instruments: polarizer – Refractometer – Pycnometer – Use of Heavy liquids. Non destructive methods in gem Identification. Gem Simulants and Proxies. Artificial Gemstones and Substitutes.                                 |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Gemstone Cutting: Cutting Instruments: Diamond Saw – Blade. Preliminary Observations – Rough Cutting of Gemstones – Sizing and Shaping of Raw stones – Styles of Cutting: Rounding, Cabochon, Flat, Square, Rectangle, Crown, Brilliant, and Laser Sculpting                       |          |   |   |   |   |         | 12           | CO3               |          |       |
| IV                | Weight Standard Schemes used in Gemology – 4Cs Scheme for Diamonds. Polishing of Gemstones – Polishing Angles and limits. Polishing Equipments. Feasibility and Economics of Gem Industries in India with special reference to Tamil Nadu. Grading, Valuation and Pricing of Gems. |          |   |   |   |   |         | 12           | CO4               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |    |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Gemstone Prospecting: Host rocks – Gemstone Mineralization – Deposits. Exploration Techniques and Exploitation. Gemstone Occurrences in India and with special references to Tamil Nadu. | 12 | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                                                                    | 60 |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                                                                          |    |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |    |     |
| Course Outcome<br>s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | On completion of this course, students will;                                                                                                                                             |    |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basics of Gems                                                                                                                                                            |    |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of Gems with identify the test studies                                                                                                                         |    |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know different group of Gems quality of minerals systems                                                                                                                                 |    |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the descriptive Gems and value and price                                                                                                                                      |    |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of Gemstones in India                                                                                                                                          |    |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |    |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi                                                                                                       |    |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Karanth K.V. (2000), Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore                                                                                    |    |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Anderson, B.W(1990).Gem testing (10th edition), Butterworth Scientific, London. Babu, T.M.(1998) Diamonds in India. Geological Society of India, Bangalore                               |    |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Hall, C.(1994).Gemstone, Dorling Kindersley, London                                                                                                                                      |    |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Prasad U, Economic Mineral Deposits, CBS.Delhi(2003)                                                                                                                                     |    |     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |    |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | India's Mineral Resources, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi                                                               |    |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Deer, W.A., Hower, R.Abdzussman.S.(1992).An introduction to rock forming minerals, ELBS, London                                                                                          |    |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Industrial Minerals ,Sinha, R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.                                                                                                                |    |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Kerr, P.F.(1997). Optical mineralogy, 4th Ed. McGraw Hill Book & Co New York                                                                                                             |    |     |

n order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level

- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3) M-Medium (2)L-Low (1)

| Subject Code      | Subject Name                                                                                                                                                                                                                      | Category | L | T | P | S | Credits | Inst. Hours  | Marks             |          |       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|---------|--------------|-------------------|----------|-------|
|                   |                                                                                                                                                                                                                                   |          |   |   |   |   |         |              | CIA               | External | Total |
| 23UGEN E02        | OCEANOGRAPHY                                                                                                                                                                                                                      | NME      | Y |   |   |   | 2       | 2            | 25                | 75       | 100   |
| Course Objectives |                                                                                                                                                                                                                                   |          |   |   |   |   |         |              |                   |          |       |
| CO1               | Understand the basics of Ocean                                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| CO2               | Understand the importance of Major Ocean affecting factor                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| CO3               | Know different group of factor using tides                                                                                                                                                                                        |          |   |   |   |   |         |              |                   |          |       |
| CO4               | Understand the descriptive types of ocean                                                                                                                                                                                         |          |   |   |   |   |         |              |                   |          |       |
| CO5               | Understand the importance of Resource of ocean                                                                                                                                                                                    |          |   |   |   |   |         |              |                   |          |       |
| UNIT              | Details                                                                                                                                                                                                                           |          |   |   |   |   |         | No. of Hours | Course Objectives |          |       |
| I                 | Oceanography: Scope, Content, Significance, Distribution of Land and Sea - Hypsometric Curve, Surface Configuration of the Ocean Floor: Continental Shelf, Continental Slope, Deep Sea Plain, Oceanic Deeps and Submarine Canyons |          |   |   |   |   |         | 12           | CO1               |          |       |
| II                | Relief Features of the Major Oceans: Atlantic, Pacific and Indian Ocean –Horizontal and Vertical Distribution of Seawater Temperature. Salinity: Factors Affecting Salinity and Distribution                                      |          |   |   |   |   |         | 12           | CO2               |          |       |
| III               | Ocean Water Circulation: Factors Influencing Ocean Circulation - General Circulation of Ocean Currents,                                                                                                                           |          |   |   |   |   |         | 12           | CO3               |          |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                      |    |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|----|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Currents of the Atlantic, Pacific and Indian Ocean, Waves and Tides: Definition and Types, Tsunamis: Origin and Effects              |    |     |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marine Deposits: Classification and Distribution - Coral Reefs types - Conditions for the Growth                                     | 12 | CO4 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Marine Resources: Types - Distribution and Uses - Tidal Energy - Role of National Institute of Oceanography in India                 | 12 | CO5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total                                                                                                                                | 60 |     |
| <p>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.</p> <p>The blooms taxonomy verbs will be given as a separate annexure for your reference.</p> <p>Each course outcome should be mapped with the POs.</p> <p>The mapping of each CO can be done with any number of POs.</p> |                                                                                                                                      |    |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                      |    |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | On completion of this course, students will;                                                                                         |    |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the basics of Ocean                                                                                                       |    |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To Understand the importance of energy source in ocean studies                                                                       |    |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Know different tides form oceans                                                                                                     |    |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the descriptive descriptivetypes of ocean                                                                                 |    |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Understand the importance of oceans in India                                                                                         |    |     |
| Text Books<br>(Latest Editions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                      |    |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Anikouchine, W. A. and Sternberg, R. W., (1973): The World Oceans - An Introduction to Oceanography, Englewood Cliffs.               |    |     |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Garrison, T., (1998): Oceanography, Wadsworth Co.USA                                                                                 |    |     |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Gerald, S. (1980): General Oceanography: An Introduction, John Wiley & Sons, NewYork                                                 |    |     |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | King, C. A. M., (1972): Beaches and Coasts, E. Arnold, London: King, C. A. M.,(1975): Oceanography for Geographers, E. Arnold,London |    |     |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Ramasamy, G., (1970): Oceanography (Tamil Edition), Tamil Nadu Text Book Society,Chennai                                             |    |     |
| References Books<br>(Latest editions, and the style as given below must be strictly adhered to)                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                      |    |     |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sharma, R. C. and Vatel, M., (1970): Oceanography for Geographers, CheytanyaPublishingHouse, Allahabad                               |    |     |

n order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|------|------|------|------|------|------|------|------|
| CO 1 | 3    | 3    | 2    | 3    | 3    | 3    | 2    | 2    |
| CO 2 | 2    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |
| CO 3 | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 1    |
| CO 4 | 3    | 3    | 3    | 3    | 3    | 2    | 1    | 1    |
| CO 5 | 2    | 1    | 1    | 2    | 1    | 1    | 2    | 2    |

S-Strong(3)    M-Medium (2)L-Low (1)S