**Appendix 3**

 **(M.Sc. in Geology)**

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###### JAI NARAIN VYAS UNIVERSITY, JODHPUR

###### FACULTY OF SCIENCE

###### NEW CAMPUS

GUIDELINES FOR CHOICE BASED CREDIT SYSTEM:

**Definitions of Key Words:**

* 1. **Academic Year**: Two consecutive (one odd + one even) semesters constitute one academic year.
	2. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed elective and skill courses.A student need to select **two elective papers** offered by the Department in which he/she is doing core course this shall be part of core programme during third and fourth semester. Each student has to complete **four skill courses**: two within the Department and two from other Department within JNV University or the Universities approved by JNV University
	3. **Course**: Usually referred to, as ‘papers’ is a component of a programme. All coursesneed not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ project work/ self-study etc. or a combination of some of these.
	4. **Credit Based Semester System (CBSS)**: Under the CBSS, the requirement forawarding a degree is prescribed in terms of number of credits tobe completed by the students.
	5. **Credit Point**: It is the product of grade point and number of credits for a course.
	6. **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one period of teaching (lecture or tutorial) or two periods of practical work/field work per week.
	7. **Cumulative Grade Point Average (CGPA)**: It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
	8. **Grade Point**: It is a numerical weight allotted to each letter grade on a 10-point scale.
	9. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
	10. **Programme**: An educational programme leading to award of the Postgraduate Degree in the Core subject in which he/she is admitted.
	11. **Semester Grade Point Average (SGPA)**: It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
	12. **Semester**: Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to November/ December and even semester from December/January to May.

**Odd semester University examination shall be during second/third week of December and even semester University examination shall be during second/third week of May. Each Department shall conduct the Practical examinations of Odd semester with internal examiners only; however during even semester one Examiner shall be from other University/Institute**.

* 1. **Transcript or Grade Card or Certificate:** Based on the grades earned, a statement of gradesobtained shall be issued to all the registered students after every semester. This statement will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester

**Fairness in Assessment**

Assessment is an integral part of system of education as it is instrumental in identifying and certifying the academic standards accomplished by a student and projecting them far and wide as an objective and impartial indicator of a student’s performance. Accordingly the Faculty of Science resolves the following:

1. All internal assessments shall be open assessment system only and that are based on Quizzes, term test, seminar
2. Attendance shall carry the prescribed marks in all papers and Practical examination internal assessment
3. In each semester three out of four theoretical component University examination shall be undertaken by external examiners from outside the university conducting examination, who may be appointed by the competent authority

**Grievances and Redressal Mechanism**

1. The students will have the right to make an appeal against any component of evaluation. Such appeal has to be made to the Head/Principal of the College or the Chairperson of the University Department concerned as the case may be clearly stating in writing the reason(s) for the complaint / appeal.
2. The appeal will be assessed by the Chairman and he/she shall place before the **Grievance Redressal Committee (GRC),** Chaired by the Dean, Faculty of Science comprising all HODs of the Faculty and if need be Course Teacher(s) be called for suitable explanation; GRC shall meet at least once in a semester and prior to CCA finalization.
3. The Committee will consider the case and may give a personal hearing to the appellant before deciding the case. The decision of the Committee will be final.

Table 1: Grades and Grade Points

|  |  |  |  |
| --- | --- | --- | --- |
| S.No. | Letter Grade | Meaning | Grade Point |
| 1 | ‘O’ | Outstanding | 10 |
| 2 | ‘A+’ | Excellent | 9 |
| 3 | ‘A’ | Very Good | 8 |
| 4 | ‘B+’ | Good | 7 |
| 5 | ‘B’ | Above Average | 6 |
| 6 | ‘C’ | Average | 5 |
| 7 | ‘P’ | Pass | 4 |
| 8 | ‘F’ | Fail | 0 |
| 9 | ‘Ab’ | Absent | 0 |

1. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.
2. For noncredit courses (Skill Courses) ‘Satisfactory’ or “Unsatisfactory’ shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

**Grade Point assignment**

= and > 95 % marks Grade Point 10.0

90 to less than 95 % marks Grade Point 9.5

85 to less than 90 % marks Grade Point 9.0

80 to less than 85 % marks Grade Point 8.5

75 to less than 80 % marks Grade Point 8.0

70 to less than 75 % marks Grade Point 7.5

65 to less than 70 % marks Grade Point 7.0

60 to less than 65 % marks Grade Point 6.5

55 to less than 60 % marks Grade Point 6.0

50 to less than 55 % marks Grade Point 5.5

45to less than 50 % marks Grade Point 5.0

40 to less than 45 % marks Grade Point 4.5

35 to less than 40 % marks Grade Point 4.0

**Computation of SGPA and CGPA:**

1. The SGPA is the ratio of sum of the product of the number of credits with the gradepoints scored by a student in all the courses taken by a student and the sum of thenumber of credits of all the courses undergone by a student,

 i.e

**SGPA** (Si) = Σ(Ci x Gi) / ΣCi

whereCi is the number of credits of the ith course and Gi is the grade point scored by thestudent in the ith course.

1. The CGPA is also calculated in the same manner taking into account all the coursesundergone by a student over all the semesters of a programme,

i.e.

**CGPA =** Σ(Ci x Si) / Σ Ci

where Si is the SGPA of the ith semester and Ci is the total number of credits in thatsemester.

1. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in thetranscripts.

***Illustration* for SGPA**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course**  | **Credit** | **Grade letter** | **Grade point** | **Credit Point**(Credit x Grade) |
| **1** | Course 1 | **4** | **B** | **8** | **4 x 6 =24** |
| **2** | Course 2 | **4** | **B+** | **7** | **4 X 7 =28** |
| **3** | Course 3 | **4** | **B** | **6** | **4X 6 = 24** |
| **4** | Course 4 | **4** | **O** | **10** | **4 X 10 =40** |
| **5** | Course 5-Practical I | **4** | **C** | **5** | **4 X 5 =20** |
| **6** | Course 6 – Practical II | **4** | **B** | **6** | **4 X 6 = 24** |
|  | Total | **24** |  |  | **24+28+24+40+20+24 =160** |

Thus, **SGPA =160/24 =6.67**

***Illustration* for CGPA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Semester- I** | **Semester-II** | **Semester-III** | **Semester-IV** |
| **Credit** | **24** | **24** | **24** | **24** |
| **SGPA** | **6.67** | **7.25** | **7** | **6.25** |

**CGPA = (24X6.67+ 24X 7.25 + 24X7 + 24 X 6.25)/ 96**

 **652.08/96 = 6.79**

The Department is free to distribute the Periods between Theory/Tutorial/Practical as per the Course content and the need of the course. However the selection shall be from any one of the following pattern

4 : 0 : 0 (four lectures only (no tutorial and no practical) per week).

2 : 1 : 1 (two lectures, one tutorial, and one practical per week).

0 : 2 : 2 (no lecture, two tutorials, and two practicals per week).

1 : 2 : 1 (one lecture, two tutorials, and one practical per week).

2 : 2 : 0 (two lectures, two tutorials, and no practical per week).

0 : 4 : 0 (no lecture, four tutorials only, and no practical per week).

1 : 1 : 2 (one lecture, one tutorial, and two practicals per week).

2 : 0 : 2 (two lectures, no tutorial, and two practicals per week).

0 : 0 : 4 (no lecture, no tutorial, and four practicals only per week).

1 : 0 : 3 (one lecture, no tutorial, and three practicals per week).

3 : 1 : 0 (three lectures, one tutorial, and no practical per week).

0 : 1 : 3 (no lecture, one tutorial, and three practicals per week).

1 : 3 : 0 (one lecture, three tutorials, and no practical per week).

3 : 0 : 1 (three lectures, no tutorial, and one practical per week).

0 : 3 : 1 (no lecture, three tutorials, and one practical per week).

The Duration of the Period shall be forty five minutes. In each of these combinations, the first value stands for the same number of lecture instructions per week, whereas the last two values stand for double the number of tutorial / practical instructions per week.

In each practical group the number of students that can be accommodated will be decided by the respective Department Council; the general/existing pattern is 15 to 20 students in each group. The workload is to be computed accordingly.

**Course Evaluation (Evaluation of the Students)**

All courses (Core/ Elective) involve an evaluation system of students that has the following two components:-

* 1. **Continuous Comprehensive Assessment (CCA)** accounting for 30% of the final grade that a student gets in a course; and
	2. **End-Semester Examination (ESE)** accounting for the remaining 70% of the final grade that the student gets in a course.
1. **Continuous Comprehensive Assessment (CCA)**: This would have the following components:
	1. **Quizzes:** Two Quiz examinations of 45 minutes duration each having a maximum of 40 marks shall be arranged for theory paper during the semester course period
	2. **Term Test**: One term test shall be arranged for each theory paper prior to End-Semester Examination; examination duration shall be of three hours; maximum marks is 70
	3. **Seminar**: Each student shall prepare and deliver a seminar per theory paper; maximum marks shall be 15. The seminar shall commence after first quiz examination and shall be completed prior to term test for all the papers.
	4. **Classroom Attendance –** Each student will have to attend a minimum of 75% Lectures / Tutorials / Practicals. A student having less than 75% attendance will not be allowed to appear in the End-Semester Examination (ESE). Attendance shall have 15 marks and will be awarded by following the system proposed below:

Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:-

75% to 80% = 3 marks

80% to 85% = 6 marks

85 to 90% = 9 marks

90% to 95% = 12 marks

˃ 95% = 15 marks

**All students’ cumulative attendance shall be displayed in the Department Notice Board every month with a copy to the Dean, Faculty of Science.**

* 1. CCA are based on open evaluation system without any bias to any student
	2. Any grievance received in the Department from student shall be placed before the **Grievance Redressal Committee** with adjudicated comments

Each component marks will be added without rounding and the total thus obtained is ratio by a factor of six. This value shall be rounded.

Illustration : Quiz 1 – Marks obtained = 30

 Quiz 2 – Marks obtained = 35.5

 Term Test Marks obtained = 50.5

 Seminar Marks obtained = 14

 Attendance Marks obtained = 9

 Total = 139.00

 Conversion = 139/6 = 21.16666

 Award = 22.00

**Skill Course Evaluation:** Based on his/her performance and hands on practice, the respective Department shall declare the result as “Satisfactory” or “Non-Satisfactory”; each student need to get a minimum of three “Satisfactory” declaration for the course completion

**In laboratory courses (having only practical (*P*) component**), the CCA will be based on students attendance (50%); hands on Practical in physical science stream (50%) and collection of biological material (25%) and hands on Practical (25%) in biological and earth science stream.

**For QUIZ** (2 quizzes per semester), 40 marks per Quiz and total of 80 marks, 45 minutes duration for each quiz:

|  |  |  |  |
| --- | --- | --- | --- |
| Types of question | Number of Questions | MarksPer question | Total marks per type |
| 1. Multiple choice
2. Fill in the blanks
3. Short answer (15 words)
 | 10105 | 122 | 102010 |
| Total | 25 |  | 40 |

**For the Term test and ESE**:

**Part A**

Ten short type questions (Definitions, functions, short explanations, etc) for two marks each. 10 × 2= 20 marks; two questions from each Unit; no choice in this part

**Part B**

Five short answer (250 words) type questions for four marks each. 5 × 4 = 20 marks; one question from each Unit with internal choice

**Part C**

Five questions of long/explanatory Answer (400 words) type, one drawn from each Unit; student need to answer any three; ten marks each; 3 × 10 = 30 marks

**20+20+30 = 70 marks**

**Qualifying for Next semester**

* + 1. **A student acquiring minimum of 35% in total of the CCA is eligible to join next semester**.
		2. A student who does not pass the examination (CCA+ESE) in any course(s) (or due to some reason as he/she not able to appear in the ESE, other conditions being fulfilled, and so is considered as ‘Fail’), shall be permitted to appear in such failed course(s)’in the subsequent ESE to be held in the following October / November or April / May, or when the course is offered next, as the case may be.
		3. A student who fails in one or more papers in a semester shall get three more chances to complete the same; if he/she fails to complete the same within the prescribed time i.e. three additional chances for each paper; the student is ineligible for the Postgraduate degree in the Subject in which he/she is admitted. Additional chances examination fee shall be on additive basis.

**Improvement Option**:

Every student shall have the opportunity to improve Credit thorough University Examination only. Improvement opportunity for each paper is only with two additional chances; improvement examination fee shall be on additive basis; the Credit obtained in improvement examination shall be final. There shall be no improvement opportunity in Practical examinations**.**

**Result Declaration:**

The ESE (End Semester Examination/University Examination) results shall be declared within twenty days of the last examination. The Theory/ Practical Classes of even semesters shall begin from the next day of ESE; whereas odd semester classes shall commence after summer vacation.

**M.Sc. Previous Geology: Semester I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of course** | **Course code** | **Title of the Course** | **Lecture-Tutorial-Practical/Week** | **No. of credits** | **Continuous Comprehensive Assessment (CCA)** | **End-Semester Examination (ESE)****[University Examination]** | **Total** |
|  |  |  |  |  |  |  |  |
| **Core course 1** | **Geol. 101** | **Mineralogy**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 2** | **Geol. 102** | **Structural and Field Geology**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 3** | **Geol. 103** | **Geomorphology and Global Tectonics**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 4** | **Geol. 104** | **Sedimentology**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course Practical 1** | **Geol. 105** | **Mineralogy, Structural and Field Geology**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Core course Practical 2** | **Geol. 106** | **Geomorphology, Global Tectonics and Sedimentology**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Skill Development Course I** | **Geol. 107****(any one)** | 1. **Topographic Survey**
 | **2-0-2** |  |  |  |  |
| 1. **Field Geology**
 | **2-0-2** |
|  |  |  |  | **24** | **180** | **420** | **600** |

**M.Sc. Previous Geology : Semester II**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of course** | **Course code** | **Title of the Course** | **Lecture-Tutorial-Practical/Week** | **No. of credits** | **Continuous Comprehensive Assessment (CCA)** | **End-Semester Examination (ESE)****[University Examination]** | **Total** |
| **Core course 5** | **Geol. 201** | **Precambrian Stratigraphy** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 6** | **Geol. 202** | **Igneous Petrology** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 7** | **Geol. 203** | **Phanerozoic Stratigraphy**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 8** | **Geol. 204** | **Palaeobiology**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course practical 3** | **Geol. 205** | **Precambrian Stratigraphy, Igneous Petrology and Geological Tour**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Core course practical 4** | **Geol. 206** | **Palaeobiology & Phanerozoic Stratigraphy**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Skill Development course II** | **Geol. 207 (any one)** | 1. **Minerals and rocks**
 | **2-0-2** |  |  |  |  |
| 1. **Building and Decorative Stone**
 | **2-0-2** |
|  |  |  |  | **24** | **180** | **420** | **600** |

**M. Sc. Final Geology: Semester III**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of course** | **Course code** | **Title of the Course** | **Lecture-Tutorial-Practical/Week** | **No. of credits** | **Continuous Comprehensive Assessment (CCA)** | **End-Semester Examination (ESE)****[University Examination]** | **Total** |
|  |  |  |  |  |  |  |  |
| **Core course 1**  | **Geol. 301** | **Hydrogeology** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 2**  | **Geol. 302** | **Ore Genesis and Mineral Deposits** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 3**  | **Geol. 303** | **Metamorphic Petrology and Geochemistry** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 4**  | **Geol. 304** | **Tectonics - Stratigraphy and Sedimentation** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course practical 1** | **Geol. 305** | **Hydrogeology, Ore Genesis Mineral Deposits and Groundwater training** | **0-0-8** | **4** | **30** | **70** | **100** |
| **Core course practical 2** | **Geol. 306** | **Metamorphic Petrology, Geochemistry and Sedimentary Exercises** | **0-0-8** | **4** | **30** | **70** | **100** |
| **Skill Development Course I**  | **Geol. 307** | 1. **Remote Sensing**
 | **2-0-2** |  |  |  |  |
| 1. **Ore Reserve Estimation**
 | **2-0-2** |
|  |  |  |  | **24** | **180** | **420** | **600** |

**M. Sc. Final Geology; Semester IV**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of course** | **Course code** | **Title of the Course** | **Lecture-Tutorial-Practical/Week** | **No. of credits** | **Continuous Comprehensive Assessment (CCA)** | **End-Semester Examination (ESE)****[University Examination]** | **Total** |
| **Core course 1**  | **Geol. 401** | **Industrial Minerals and Mineral Fuel** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 2**  | **Geol. 402** | **Mineral Prospecting and Exploration**  | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 3**  | **Geol. 403** | **Geoinformatics and Geo-environment** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course 4**  | **Geol. 404** | **Mining and Engineering Geology** | **4-0-0** | **4** | **30** | **70** | **100** |
| **Core course practical 1** | **Geol. 405** | **Industrial mineral, Mineral Fuel and Exploration**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Core course practical 2** | **Geol. 406** | **Geoinformatics, Geoenvironment, Mining and Engineering Geology**  | **0-0-8** | **4** | **30** | **70** | **100** |
| **Skill Development Course II** | **Geol. 407** | **A.Groundwater** | **2-0-2** |  |  |  |  |
| **B.Geohazards** | **2-0-2** |
|  |  |  |  | **24** | **180** | **420** | **600** |

* 1. **Seminar**: Each student shall prepare and deliver a seminar per theory paper; maximum marks shall be 15. The seminar shall commence after first quiz examination and shall be completed prior to term test for all the papers.
	2. **Classroom Attendance –** Each student will have to attend a minimum of 75% Lectures / Tutorials / Practicals. A student having less than 75% attendance will not be allowed to appear in the End-Semester Examination (ESE). Attendance shall have 15 marks and will be awarded by following the system proposed below:

Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:-

75% to 80% = 3 marks

80% to 85% = 6 marks

85 to 90% = 9 marks

90% to 95% = 12 marks

˃ 95% = 15 marks

**Each student’s cumulative attendance shall be displayed in the Department Notice Board every month with a copy to the Dean, Faculty of Science.**

Condonation of Shortage of attendance shall be governed in accordance with the provisions in the Act and Statute of the University vide Ordinance 78 to Ordinance 80 as amended from time to time.

Second addition:

**Qualifying for Next semester**

* + 1. **A student acquiring minimum of 40% in total of the CCA is eligible to join next semester**.
		2. A student who does not pass the examination (CCA+ESE) in any course(s) (or due to some reason as he/she not able to appear in the ESE, other conditions being fulfilled, and so is considered as ‘Fail’), shall be permitted to appear in such failed course(s) in the subsequent ESE to be held in the following October / November or April / May, or when the course is offered next, as the case may be.
		3. A student who fails in one or more papers in a semester shall get three more chances to complete the same; if he/she fails to complete the same within the prescribed time, i.e. three additional chances for each paper; the student is ineligible for the Postgraduate degree in the Subject in which he/she is admitted, for additional chances examination fee shall be on additive basis.

**Improvement Option**:

Every student shall have the opportunity to improve Credit thorough University Examination only. Improvement opportunity for each paper is only with two additional chances; improvement examination fee shall be on additive basis; the Credit obtained in improvement examination shall be final. There shall be no improvement opportunity in Practical examinations**.**

**Result Declaration:**

The ESE (End Semester Examination/University Examination) results shall be declared within twenty days of the last examination. The Theory/ Practical Classes of even semesters shall begin from the next day of ESE; whereas odd semester classes shall commence after summer vacation.

**Students Failed in CCA**:

Any student declared “Not Eligible” by the Department based on CCA in Semester I, II, III or IV and accordingly did not appear in ESE; can be readmitted as an additional student in that Semester in the **following year only**. Such student need to deposit the annual university fee as prescribed for that academic year.

**M. Sc. Geology Syllabus ( 2017- 2019)**

**SEMESTER I (2017- 2018)**

 **1. Core Paper Geol. 101: Mineralogy**

***Unit – I***

Introduction to Periodic table. Co-ordination number and bonding in Minrals; Crystallographic concepts: Crystal forms, Symmetry elements, Unit cell, Introduction to Bravais lattices and space groups; Crystal imperfections: defects, zoning and Twinning.

***Unit – II***

Crystal systems and their 11 symmetry classes; Structural classification of silicates. Isomorphism, polymorphism and Pseudomorphism.

***Unit – III***

Polarized light, Refractive Index, Double refraction, birefringence and Nicol prism. Study of orthoscopic and conoscopic properties of minerals. Dispersion in minerals, sign of elongation, determination of fast and slow vibrations and accessory plates. Uniaxail and biaxial indicatrix and interference figures.

***Unit - IV***

Silicate mineralogy: structure, mineral chemistry, P.T. stability, Physical and optical properties and mode of occurrence of Quartz (Silica), Feldspar, Feldspathoid, Garnet, Epidote, and Aluminosilicates.

***Unit – V***

Silicate mineralogy: structure, mineral chemistry, P.T. stability, Physical and optical properties and mode of occurrence of Pyroxene, Amphibole, Mica and Olivine. Physical and optical properties of following Minerals: Chlorite, Calcite, dolomite, Apatite, corundum, zircon, scapolite and sphene.; Clay Minerals: Properties and occurrences. Bragg’s Law.

**Paper Geol. 102: Structural and Field Geology**

***Unit – I***

Structural behavior of igneous rocks, Diapirs and salt Domes. Cleavage: Types, origin, mechanics and relationship with folding. Lineation: Types, origin and deformation. Basic principles of structural analyses.

***Unit – II***

Principles of geological mapping, methods of contact mapping, Field equipments and toposheets, map reading, mapping in multigeneration folded terrain, Method of measuring strike and dip in the field and plotting of cross sections.

***Unit - III***

Concept of petrofabrics and symmetry; Types of fabrics, fabric elements, π and β diagrams; Thrust geometry. Mechanical principles and properties of rocks; Rock theory and methods. Concept of stress and strain; Stress and its components, stress in two and three dimensions; Types of strain ellipses and ellipsoids, their properties and geological significance ; Mohr diagrams; Varities of deformative forces.

***Unit - IV***

Folds: Geometry, classification, mechanism of folding and projection diagrams. The dynamic factor conditioning in the formation of folds. Recognition of fold in the field.

***Unit - V***

Faults: Geometry, classification, mechanism of faulting. Recognition of faults in the field. Unconformities and basement-cover relations. Shear zones, Shear sense indicators, shear zone kinematics. Role of fluids. Mylonites and cataclasites, their origin and significance. Behaviour of minerals and rocks under deformation conditions. Time relationship between crystallization and deformations.

**Paper Geol. 103: Geomorphology and GlobalTectonic**

***Unit I***

Concepts of Geomorphology, soilk, soil profile and climatic characteristics. Geomorphic land forms and processes, Agradational processes: Volcano – Types, causes and products. Degradational Processes: Weathering, Erosion and mass wasting. Streams and their geological work, Drainage patterns, Morphometric basin analysis. Erosion by stream: Deepening, widening, headward and base level of erosion stages of rivers. Erosion, transportation and deposition landforms. River capture and river pieracy. Palaeodrainages.

**Unit - II**

Geomorphological divisions of India. Morphological zones and origin of Himalaya. Indogangetic alluvium, Peninsular India, Indian Rivers, mountains, glaciers, lakes, islands and coasts. Earthquakes and Seismic zones of India. Geological work and landforms of Glaciers, Groundwater Wind.

 **Unit - III**

Concept of Continental drift. The Theory of Plate Tectonics, Type of Plates. Causes of Plate movements, Rate of Plate movement. Triple junction and opening of Sea. Mid-Oceanic Ridges. Subduction Zone and Benioff zone. Deep Sea Trenches, Island and Volcanic Arcs. Mantlr Plume and Plume mechanism. Palaeomagnetism.

**Unit- IV**

Applied Plate Tectonics for Seismisity, Mountain building, Fuel and Mineral exploration, Igneous rocks and Metamorphism. Applied Geomorphology for mineral prospecting, Civil Engineering projects, Environment studies and Terrain evaluation for strategic purposes. Geomorphological indications of Neotectonics: Stream drainages, Drainage modification, fault reactivation, vertical movement in stable sand at coasts and Deserts.

**Unit- V**

Introduction to Oceanography, Geological work of Sea, Morphology of Ocean bottoms, Littoral zone, continental shelf, continental slope and Abyssal zone, Deep Sea Trench,, Coral Reefs, island, Coastal morphology, Temperature, Salinity, Density and Ice in Sea. Ocean waves, Tides and currents, El Nino and La Nino. Marine Resources: Organic and carbonate deposits, polymetallic Nodules, Gashydrates and off shore Petroleum resources. Morphology of Indian Ocean.

**Paper Geol. 104: Sedimentology**

**Unit I**

Earth surface system: weathering, erosion, process of transportation, deposition and post depositional changes and Diagenesis. Sedimentary textures: grain size and their classification. Granulometric Analysis and interpretation of grain size data with the help of graphic measures and Stastical parameters. Grain shape and their classification. sorting, packing and orientation. Imlications and significance of textures. Mineralogical characteristics and Mineral stability. Heavy minerals : heavy mineral Suites and significance of Heavy minerlas.

**Unit II**

Sedimentary structures: Mechanical, chemical and Biogenic and Biochemical sedimentary structures. Deformed bedding structures. Significance of Sedimentary Structures. Sedimentary Environments and Facies: Non- Marine ( Aquous) Sedimentary Environments: continental alluvial-fluvial, lacustrine and glacial sedimentary system.

**Unit III**

Sedimentary environments and Facies: Non- Marine Sedimentary Environments - continental Desert-Aeolion sedimentary system. Deltaic Sedimentary Environments.

Marine Sedimentary Environments: Shallows coastal, Beach, shelf and deep Marine Sedimentary Environments. Mixed Sedimentary Environments: Barrier Islands, Environments.

**Unit IV**

Sedimentary Petrology: Characterstics and Petrogenesis of important Clastic Sedimentary Rocks: conglomerate, Breccia, pebbly sandstone, sandstone, quartz arenites, arkose, grawack, siltstone, shale bone bed. Non Clastic Sedimentary Rocks: micritic, microsparitic and sparitic limestone, dolomites, bedded phosphorite, and biogenic Sedimentary Rocks ( stromatoloitic limestone and phosphorite, oncolitic phosphorite, fossiliferous limestone, coqunoidal limestone).

**Unit V**

Classification of Rudaceous, Aranaceous and Argillaceous Clastic Sedimentary Rocks. Folk and Dunham's classification of Non-Clastic Sedimentary Rocks. Palaeocurrent and tools of paleocurrent. Palaeocurrent analysis for palaeoenvironmental and basin analysis. Definations and Elimentary idea of sedimentary Basins.

**PRACTICAL: Geol. 105**

**Mineralogy, Structural and Field Geology**

1. Identification and Physical properties of common minerals.
2. Identification and optical properties of minerals under petrological microscope
3. Identification of crystal forms in models and their axial, symmetrical and notational characteristics.
4. Identification of common features in Geological Maps.
5. Outcrop completion maps.
6. Preparation of Cross Section of Geological Maps, dealing with simple contacts, unconformities and their combinations.
7. Structural Problems related to stereographic projections.
8. Extensive Structural Geological Field study and camp\* at one **/** various locations for Geological Mapping, Preparation of report and viva voce exam

**Note**\* Structural Geological Field study and camp is essiential part of the syllabus.

**PRACTICAL: Geol. 106**

**Geomorphology, Global Tectonics and Sedimentology**

1. Draw tectonomorphic divisions of India in map of India
2. Identification and description of various landforms in models and drawings.
3. Grain size analysis and granulometric analysis: Graphical representation: Histogram and cumulative frequency distribution curve of grain size data. statistical representation: computation of statistical parameters such as median, mean, standard deviation, skewness and kurtosis etc. and their interpretation for paleoenvironments.
4. Identification, characteristics and Petrogenesis of important sedimentary rocks based on their megascopic characters: 1. clastic Sedimentary Rocks (Oligomictic conglomerate and Polymictic conglomerate, Breccia, pebbly sandstone, Fine grained sandstone, medium grained sandstone and coarse grained sandstone, quartz arenites, arkose, grawack, siltstone, shale, bone bed; 2. non clastic Sedimentary Rocks ( micritic limestone, microsparitic limestone and sparitic limestone, dolomite, bedded phosphorite, and 3. biogenic Sedimentary Rocks ( stromatoloitic limestone and stromatoloitic phosphorite, oncolitic phosphorite, fossiliferous limestone, coqunoidal limestone ).
5. Identification and Petrography of important clastic and non-clastic sedimentary rocks based on their microscopic characters: shale, siltstone, Fine grained sandstone, medium grained sandstone, coarse grained sandstone, quartz arenites, arkose, graywack, pebbly sandstone, bone bed, micritic limestone, microsparitic limestone and sparitic limestone, bedded phosphorite, stromatolitic limestone and phosphorite and fossiliferous limestone etc.

**Geol. 107(Any One): SKILL DEVELOPMENT COURSE:**

1. **Topographic Survey**
2. Principles of surveying. Survey equipments.
3. Radial method of plane table survey.
4. Plane table survey with intersection methods.
5. Pace/Tape and compass methods survey with theodolite with various applications.
6. **Field Geology**
7. Field study of Igneous, Metamorphic and Sedimentary Rocks.
8. Observation of attitudes of Planar Structures.

**SEMESTER II ( 2017- 2018)**

**Paper Geol. 201 : Precambrian Stratigraphy**

**Unit I**

History and Development of Stratigraphy. Geological Time-scale and its equivalent Indian rocks. Study of standard stratigraphic code (Lithostratigraphic, Biostratigraphic and Chronostratigraphic) and Nomenclature. Early history of the Earth Nature. Nature and forms of Precambrian life. Evolution of Granite- Greenstone and Granulites belts during Precambrian Time.

**Unit II**

Major Stratigraphic breaks and events in Stratigraphy. Episodic nature of the stratigraphic records. Radioisotopes and idea of Radiometric dating methods: K-Ar dating; Rb–Sr isochron method; Sm-Nd dating; U-Th-Pb system; Radiocarbon, Fission Track (FT) and OSL dating techniques; Dendrochronology and Lichenometry.

**Unit III**

Tectonic framework. Detaild Precrambrain stratigraphy of Dharwar craton and mobile belt. Including Dharwar and Cuddapah Supergroups. Precambrian stratigraphy of Bundelkhand craton including BGC of Rajasthan.

**Unit IV**

Lithology, classification, structures and economic importance of Aravalli Supergroups, Delhi Supergroups and Vindhyan Supergroups. Precambrian-Cambrian boundary.

**Unit V**

Precambrain stratigraphy of Singbhum craton and Baster craton. Malani Igneous Suite of rocks. Lithology, Classification, Paleontology and Economic importance of Marwar Supergroup and their equivants in western Rajasthan.

**Paper Geol. 202: Igneous Petrology**

**Unit -I**

Magma: Composition and constitution of magma; Generation and Emplacement of Magma and its relation to plate tectonics; Bowen’s Reaction Principle. Magmatic crystallization, differentiation and assimilation,

***Unit – II***

Igneous Rocks: Intrusive Forms and Extrusive Forms; Textures and Structures of Igneous rock and their significance; Field Classification of igneous rocks, Mineralogical classification of igneous rocks, Chemical classification of igneous rocks including CIPW norm classification.

***Unit – III***

Crystallization process in silicate melts in light of experimental studies especially for following systems: Binary Systems ( Diopside-Anorthite, Forsterite-silica and leucite-silica system). Ternary Systems (Diopside- Albite- Anorthite, Diopside, Forsterite-Silica), their relation to magma genesis and crystallization behaviour.

**Unit – IV**

Petrograhic Provinces: Definition and characteristics; Origin of major igneous rock types viz Granites, Basalts and Alkaline rocks.

**Unit – V**

Petrography, mode of occurrence and petrogenesis of following Igneous rocks: Granites, Syenite, Nepheline; syenite; Granodiorite; Diorite; Anorthosite; Gabbro; Pyroxinite, Dunite, Dolerite; Pegmatites; Granite Porphary; Syenite Porphary, Rhyolite; Trachyte, Vesicular and Amagdalodal Basalt.

**Paper Geol. 203: Phanerozoic Stratigraphy**

**Unit –I**

Nomenclature, classification, distribution, succession, history of sedimentology, fossil content, age, palaeogeography, palaeoclimate and regional correlation of the Paleozoic formatios of India with special refernce to type localities.

**Unit- II**

Permian-Triassic boundary. Nomenclature, classification, distribution, succession, sedimentary history, fossil content, age, palaeogeography and palaeoclimate of the Mesozoic marine formations of India. Including marine Triassic sequences of the Spiti. Jurassic of Kachchh and Western Rajasthan, Cretaceous of Tiruchirapally and Western Rajasthan. Bagh Beds.

**Unit- III**

Deccan Volcanic Province: Stratigraphy and Field Features of Basalt Flows, Age and Duration of Volcanism. Inter- Trappeans and associated sedimentary Formations.

Nomenclature, classification, distribution, structures, succession, sedimentary history, fossil content, age, palaeogeography, palaeoclimate and regional correlation of the Gondwana Supergroup of India and associated coal Deposits. Cretaceous/ Tertiary (K/T) Boundary.

**Unit- IV**

Nomenclature, classification, distribution, succession, sedimentary history, Fossil content, age, palaeogeography and palaeoclimate of the Tertiary Rocks of India including Assam, Rajasthan, Gujarat, and Andman Nicobar.

**Unit – V**

Origin of Indogangetic plains, Origin of Indian desert. Nomenclature, classification distribution succession, sedimentary history, Fossil content, age, palaeogeography and palaeoclimate of Siwalik Supergroup. Karewa of Kashmir. Introduction to Quaternary Stratigraphy of India.

**Paper Geol. 204 : Palaeobiology**

***Unit - I***

Origin of life, major events in the history of Precambrian and Phanerozoic life. Major evolutionery theories. Species concepts and Nomenclature. Introduction to Biostratigraphy and Palaeobiogeography. Palaeoecology: ecosystem and limiting environmental factors. Collection, preparation and preservation of megafossils. Mass extinction and its causes.

***Unit - II***

Significance of micropaleontology. Methods & technique in study of microfossil, nannofossils and ichnofossils. Foraminifers: Morphology, Classification, evolution, geological history, and palaeoecology. Ostracods: Morphology, Classification, palaeoecology, and geological history.

Graptolites : Evolution, palaeoecology and geological history.

***Unit - III***

Functional morphology of Anthozoans (corals) and their geological history.

Brachiopoda: Classification; Variation in brachial skeleton, pedical opening and commissure.

Pelecypoda (Bivalvia or Lamellibranchia): Evolution of hinge and dentition, adaptive modification of foot, mantle and pallial sinus; palaeoecology, geological history and classification

Gastropoda: forms, various apertures, classification, palaeoecology, and geological history.

***Unit - IV***

Cephalopoda: Ammonite - Morphology, ornamentation and type of sutures, evolutionary theories about ammonite, classification and geological history. Nautiloidea: variation of conchs of nautiloidea, Morphology of Dibranchia.

Trilobite: evolutionary trends, geological history and palaeoecology.

Echinoidea: Change in symmetry, variation in oculogenital system, ambulacral areas and compound plates, classification, and geological history.

**Unit - V**

Vertebrates of Siwalik. Evolutionary histories of man, elephant and horse. Gondwana flora and their significance. Introduction to Palynology. (Spores and pollen grains).

**PRACTICAL :**

**Geol. 205: Precambrian Stratigraphy, Igneous Petrology and Geological tour**

1. Identification, Characterstics and Petrography of following Igneous rocks based on their Megascopic characters: Granites, Syenite, Nepheline; syenite Granodiorite; Diorite; Anorthosite; Gabbro; Pyroxinite, Dunite, Dolerite; Pegmatites; Granite Porphary; Syenite Porphary, Rhyolite; Trachyte, Vesicular and Amagdalodal Basalt (Igneous rocks samples).
2. Identification and Petrography of Igneous rocks under Petrological microscopes of following Igneous rocks: Granites, Syenite, Nepheline; syenite; Diorite; Anorthosite; Gabbro; Pyroxinite, Dunite, Dolerite; Pegmatites; Granite Porphary; Syenite Porphary, Rhyolite; Trachyte, Vesicular and Amagdalodal Basalt.
3. CIPW norm calculation.
4. Palaeogeographical and Stratigraphic maps of India during Precambrian time.
5. Characteristic rocks of Precambrian Stratigraphy and their correlation.
6. Extensive Field study at various locations in Geological tour\*, Preparation of report and viva voce exam

**Note**\*: Geological Study Tour is essential part of the Syllabus.

**Geol. 206: Palaeobiology & Phanerozoic Stratigraphy**

1. Identification and characteristic features of macrofossils.
2. Identification and characteristic features of microfossils.
3. Identification and characteristic features of Gondwana flora fossils.
4. Palaeogeographical and Stratigraphic maps of India during Phanerozoic time.
5. Characteristics rocks of Indian Phanerozoic Stratigraphy and their correlation.

**Geol. 207: (Any One) SKILL DEVELOPMENT COURSE**

**207 A. Minerals and Rocks**

Introduction to minerals and rocks:

 1. Common rock forming mineral.

2. Common non silicate minerals.

 3. Igneous rocks.

 4. Sedimentary rocks

 5. Metamorphic rocks

 **207 B. Building and Decorative Stone**

Various building stones from Igneous, Sedimentary and Metamorphic rocks. Their lithological and engineering characteristics.

 **SEMESTER III ( 2018 - 2019)**

**Geol. 301 : Hydrogeology**

**Unit I**

Groundwater: origin and types of water. Hydrological cycle and its components. Vertical distribution of water. Water table and Piezometric surface. Hydrographs, Flownets, Water table fluctuation and contour maps. Hydrogeological properties of rocks: porosity, permeability, specific yield and specific retention etc**.** Transmissivity and Storage Coefficient. Aquifers and their classification. Geological formations as aquifers.

**Unit II**

Ground water quality – physical and chemical properties of water, quality criteria for different uses (domestic, irrigation and industrial purposes). Groundwater pollution and contamination – Geogenic and Anthropogenic.  Salt water intrusion in coastal aquifers and its prevention. Ground water quality in India and Rajasthan**.**

**Unit III**

Well hydraulics: Darcy's Law and its application. Confined, unconfined, steady, unsteady and radial flow conditions. Pumping test methods, data analysis and interpretation. Evaluation of aquifer parameters of confined, semi-confined and unconfined aquifers – Thies, Thiem, Jacob and Walton methods.

**Unit IV**

Surface and subsurface geophysical methods of groundwater exploration. Role of Remote sensing in groundwater exploration and hydrogeomorphic mapping. Radioisotopes in hydrogeological studies. Types of water wells and water well drilling methods, construction, design, development and maintenance of wells.

**Unit –V**

Ground water assessment/estimation. Problems of Groundwater in over-exploitated areas. Ground water problems in urban areas. Rainwater harvesting & Artificial recharge: need and benefits, methods/techniques of artificial recharge. Conjunctive use of surface and groundwater. Hydrogeology of wetlands and arid zones of India with special reference to western Rajasthan. Groundwater provinces/scenario & resources of India. Groundwater scenario & resources of Rajasthan. Groundwater legislation in India. Ground Water Management in India.

**Geol 302 : Ore Genesis and Mineral Deposits**

**Unit I**

Brief history of development of economic Geology and modern concept of ore genesis. Spatial and temporal distribution of Ore deposit in the World. Material of mineral deposits and their formation. Principle ore mineral groups. Methods of goethermometery and geobarometry in Ore Geology. Ore texture, Paragenesis and zoning of Ore and their significance.

# Unit II

Chemical composition of Ores and host rock: bulk chemistry, major, minor, trace and rare earth elements. Stable and radiogenic isotopes. Ore microscopy: Optical principle and properties of Ore minerals. Fluid inclusion in ores: Principle, applications and limitations. Earths evolutionary history and evolutionary trends of Ore deposits. Precambrian and present Plate tectonics and genesis of Ore deposits. Classification of Ore forming processes.

**Unit III**

Ore forming processes of igneous associations with possible Indian example, Magmatic deposits associated with acidic, basic and ultra basic rocks. Mineralization associated with Komatiite (Gold), Kimberlite (Diamond), Carbonates (R.E.E), Peridotites (Cr, Ni and PGE), Granite (W and Sn) and Pegmatite’s (mica, uranium, gems and R.E.E), Cyprus type Cu-Zn deposit and Kuroko type Pb-Zn-Cu deposit. Porphyry copper.

Pegmatites: As a rock and economic deposit forming process. Simple and complex pegmatite and their genesis. Indian pegmatite belts.

Skarn and greisens deposits, contact metasomatism: role of invaded and intrusive rock. Characteristic of the deposits. Hydrothermal process and deposits. Origin and nature of hydrothermal solutions. Wall rock alteration, crustification and comb structures. Cavity filling and metasomatic replacement type of deposits. Hypo-, Meso-, Epi-, Tele-, Xeno and Lepto thermal deposits.

Volcanogenic process and deposits: characteristics, mode of occurrence and genesis of Mn nodules. Metamorphosed deposits and metamorphism as Ore forming process.

**Unit IV**

 Economic mineral deposit forming process of sedimentary association (with possible Indian examples) Sedimentation: Chemical and Clastic sedimentation, chemical precipitation of iron and Manganese deposit. Factors controlling economic concentration and their mutual dependence.

Residual concentration: characteristic of the process and controlling factors. Bauxite, classification and Indian deposits of bauxite. Blue dust Ore. Residual Cr and Ni /Au profiles.

Mechanical concentration: Eluvial, Alluvial, Wind and Beach placers, Placer gold, diamonds and thorium.

Oxidation and Supergene Sulphide enrichment: formation of solvent, dissolution migration and deposition of metals. Gossans: Type and importance.

Biogenic deposits and process.

Stratiform and Strata bound Ore deposits (Mn, Fe and Base metals).

Contemporary Ore forming systems: black and white smokers, mineralized crust, Mn nodules and Red sea.

**Unit – V**

Geology and genesis of important metallic deposits of India: iron, manganese, chromium, nickel, tin, tungsten, gold, lead, zinc, copper and aluminum deposits.

**Geol. 303: Metamorphic Petrology and Geochemistry**

**Unit I**

Agents and kinds of metamorphism; metamorphic zones; Evolution of the Becke-Grubenmann concept of depth zone, grades; iso-grades; metamorphic facies; Fabric of metamorphic rocks formed under regional, dynamic and Cataclastic metamorphisms.

 Studies of metamorphic facies: Glucophane schist facies; amphibolite facies; granulite facies, Eclogite facies.

UNIT – II

Principles of thermodynamics; Mineralogical phase rule; Graphical representation and plotting of different compositions in equilateral triangle, Representation of mixture and minerals consisting of two and three components, tie lines, Diagrammatic representation of mineral paragenesis in: ACF and A’KF diagrams, its merits and demerits.

UNIT – III

Factors of metamorphism; temperature, pressure and composition of fluid phase, role of H20and Co2, Equilibrium curves formation at different XCo2,

Principles of metasomatism and metamorphic differentiation; Petrogenetic grids, pressure, temperature, time paths, Petrological studies of Charnockite and Migmatite, paired metamorphic belts.

 UNIT – IV

Origin of elements in the Solar system, abundance of elements in the Earth crust, mantle, core and its constituents, Special properties of transition and rare earth elements.

UNIT – V

Geochemistry of atmosphere, hydrosphere and biosphere; geochemical cycles: Carbon cycle, Nitrogen cycle, Water cycle, Fundamentals of isotope geochemistry.

**Geol. 304: Tectonics, Stratigraphy and sedimentation**

**Unit I**

Tectonics and sedimentation: Sedimentary Basins: Geosynclinal Concept, Plate Tectonics Concept, Plate Movements and Sedimentary Basin Formation. Basins in extensional settings, Basins in compressional settings, Basins in stike slip and transform fault zones.

**Unit II**

Tectonics and sedimentation: Basin classification and Description: Downwarp Basin, Rift Basins, Interior Basins, Foreland Basins, Subduction Basins, Pull apart Basins, Delta type Basins and composite Basins.

**Unit III**

Stratigraphy and sedimentation: Classical Concepts in Stratigraphy, Estimation of Geological time, Dual Hierarchy in stratigraphy, Vertical and lateral relationship and cyclicity in sedimentary sequences. Elimentary idea of Lithostratigraphy, Biostratigraphy, Sequence Stratigraphy, Magnetostratigraphy, Chemostratigraphy and Seismic Stratigraphy.

**Unit IV**

Basin and Basin Analysis: Basins and its lithic fill, Paleoslope and paleocurrent, Deposional environments in sedimentary Basin, Diagenesis and Maturation of sediments. Basin Evolution and Tectonics.

**Unit V**

Sedimentary Basins of western Rajsthan: Lithology, stratigraphy, Paleontology, Sedimentary environment and Economic Geology of Nagaur - Ganganagar Basin ( Marwar Basin), Jaisalmer Basin and Barmer Basin.

**PRACTICAL**

**Geol. 305**: **Hydrogeology, Ore Genesis, Mineral Deposits and Groundwater training**

Physical properties, mode of occurrence and genesis, economic use and Indian location of important metallic minerals.

Ore microscopic study of Ores minerals textures and paragenesis.

Geological problems related with groundwater.

Collection of surface and Ground water samples from different sources and localities (Part of ground water field training).

Measurement of PH and EC of surface water and ground water using PH and EC meters respectively in the Laboratory and their interpretation for water quality.

Field training related with Economic Geology and Hydrogeology: Extensive Field study at various locations in Geological tour\* of Economic Geology, Preparation of report and viva voce exam.

**Note**\* Geological tour is an essential part of syllabus.

**Geol. 306: Metamorphic Petrology, Geochemistry and Sedimentary Exercises:**

1. Identification and characteristics of metamorphic rocks in handspecimen.
2. Identification of metamorphic rocks under petrological microscope.
3. Graphic construction of ACF AKF and AFM Diagrams
4. Study of primary, secondary and biogenic sedimentary structure in hand specimens in photographic atlas, field photography and wherever possible on the outcrops.
5. Exercise related to analysis and interpretation of Lithologs and depositional sedimentary environments using actual case histories from western Rajasthan stratigraphic record.
6. Field and laboratory techniques in sedimentology: preparation of lithologs from western Rajasthan sedimentary Basins. Thin section preparation of Sedimentary Rocks and staining techniques for carbonate rocks.
7. Demarcation of geological boundaries of important sedimentary Basins of Rajasthan.

**Geol. 307 (Any One): Skill Development Course:**

**A. Remote Sensing**

 1. Principles of remote sensing.

 2. Tool and techniques to study with areal photographs/Imageries.

 3. Study of topography with areal photos/ Imageries.

 4. Study of structural features with areal photos/ Imageries.

 5. Study of rock types with areal photos/ Imageries.

**B.Ore Reserve Estimation**

Ore reserve estimation, calculation of all category of proved, probable and possible estimation of ores reserves including all type of deposits – badded, load, veins etc.

**SEMESTER – IV : ( 2018- 2019)**

**Geol. 401: Industrial minerals and Mineral Fuels**

**Unit I**

Industrial Mineral Deposits and Industries: Refractory, abrasives, ceramics and glass, fertilizers, paints and pigment materials, cement,and gemstones.

# Unit- II

 Study of following with reference to origin, mode of occurrence ,distribution in India and uses; mica, asbestos, pyrite, barites, gypsum, bentonite, garnet, corundum, kynite, sillimanite, graphite, talc, fluorite, beryl, zircon, rock phosphate, quartz, feldspar, Diamond, Limestone, Marble, Sandstone, granite.

**Unit- III**

**Coal:** Definition and origin of kerogen and coal. Sedimentology of coal bearing strata. Rank, grade and type of coal. Indian and international classifications. Chemical characterization, proximate and ultimate analysis. Macroscopic ingredients and microscopic constituent and concept of ‘maceral’ and micro litho types.

Coal petrology, and its applications in solving industrial and geological problems. Preparation of coal for industrial purposes, coal carbonization (coke manufacture), coal gasification and coal hydrogenation. Application of coal petrology in hydrocarbon exploration.

Coal bed methane: a new energy resource. Maturation of coal and generation of methane in coal beds. Coal as reservoir. Fundamentals of coal bed methane exploration and production.

Coal forming epochs in the geological past. Geological and geographical distribution of coal deposits in India. Detail geology of some important coalfields of India.

Methods of coal prospecting and estimation of coal reserves. Coal production and problems of coal industry in India.

**Unit IV**

**Petroleum:** Its composition and different fractions. Origin, nature and migration (primary and secondary) of oil and gas. Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen.

Characteristics of reservoir rocks and traps (structural, stratigraphic and combination).

Oil field fluid – water, oil and gas occurrence. Prospecting for oil and gas, drilling and logging procedures. Oil production methods. Oil bearing basins of India (Assam, Cambay, Bombay, Krishna-Godavari and other Petroliferous basins of India) and the world. Geology of the productive oil fields of India. position of oil and natural gas in India, future prospects and the economic scenario .

**Unit V**

**Atomic fuel:** Mode of occurence and genesis of atomic minerals in nature. Atomic minerals as source of energy. Methods of prospecting and productive geological horizons in India.

Nuclear power stations of the country and future prospects. Atomic fields and environments.

**Geol. 402: Mineral prospecting and Exploration**

**Unit I**

Ore guides and controls; Ore Shoots, target rings and intersecting loci, Regional and local guides to ore, Physiographic guides, Lithological and stratigraphic guides, Structural guides and fracture pattern. Mineralogical guides, Bottoming and zoning of mineral deposits.

**Unit II**

Exploration: Basic aim of exploration. Classification of methods of exploration. Surface exploration and Sub Surface exploration. Aerial photography and remote sensing Interpretative characteristics of Aerial photographs and their application in identification of Geomorphology, Structures and Lithology for exploration.

**Unit III**

Geochemical explorations: Principles and methods of geochemical prospecting, methods of geochemical exploration, applicability and precautions in geochemical exploration. Pedo-, Litho-, Geo- and hydrogeochemical explorations.

**Unit IV**

Geophysical Exploration: Variation of Gravity over the surface of the earth. Principle of gravimeters. Gravity field surveys. Various type correction applied to gravity data. Preparation of gravity anomaly maps and their interpretations in term of shape, size and depth. Geomagnetic field of the earth . Magnetic properties of rocks . Working principle of magnetometers. Field surveys and data collection. Preparation of magnetic anomaly maps and their quantitative interpretation. Magnetic anomalies due to single pole and dipole. Introduction to Aeromagnetic survey. Three dimensional current flow, potential due to a point current source.

Resistivity Method: Basic principles, various type of electrode configurations, Field procedure: profiling and sounding . Applications of electrical methods in ground water prospecting and civil engineering problems.

**Unit V**

Seismic Methods : Fundamental principle of wave propagation, refraction and reflection surveys for single interface, horizontal and dipping cases.

Concept of seismic channel and multi-channel recording of seismic data. End- on and spread shooting technique. CDP method of data acquisition, sorting, gather stacking and record section. Seismic velocity and interpretation of seismic data.

Application in mineral and petroleum exploration. Description of borehole environment. Brief outline of various well-logging techniques. Principles of electrical logging and its application in petroleum, groundwater and mineral exploration.

**Geol. 403 : Geoinformatics and Geoenvironment**

**Unit - I**

Concepts of Environmental Geology – it's scope, objectives and aims; Application of Geology to Sustainable Development. Terrain evaluation and Land-use planning; Geological causes of Environmental degradation - lithological, structural, geomorphological and also anthropogenic causes. Pollution due to waste disposals. Introduction to Elements of Environmental Impact Assesment. Environmental Legislations in India.

**Unit – II**

Landslides: their types; Factors controlling landslides; Landslide hazard zonation mapping; Preventive and precautionary measures of Landslides and floods; Earthquake: Distribution, magnitude and intensity of earthquakes; Seismic zonation map of India; Impact of seismic hazards on long and short term environmental conditions.

**Unit – III**

Climatology: Fundamental principles of climatology. Earths radiation balance, and seasonal variation of insolation, temperature, pressured wind belts and humidity,

Water balance. Tropical cyclones and El Nino. Climatic cycles during Quaternary; Terminal Pleistocene-Holocene climatic and sea level changes.

**Unit – IV**

Fundamental principles and technology of aerial photography; types of aerial photographs; factors affecting aerial photography; types of camera, film and filters; scale of aerial photography and factors affecting scale; mosaics and annotation; relief displacement; vertical exaggeration. Stereoscopic parallex. Principles and components of GIS. Application of GIS in various geological studies.

**UNIT – V**

Concepts of remote sensing: Electromagnetic radiation – characteristics, remote sensing regions and bands. remote sensing system: space platforms and orbital patterns. Spectra of common natural objects – soil, rock, water and vegetation. Sensors: active and passive. Thermal Infra-Red remote sensing and its application. Microwave remote sensing and its application. Space research in India – Bhaskara and Indian Remote Sensing Systems and their applications. Remote sensing applications in interpreting structure and tectonics, Lithological mapping and mineral resources.

**Geol. 404 : Mining and Engineering Geology**

**Unit I**

Introduction to Mining : Mining and social economic impacts, Terminology of Mining, Basic concepts and methods of Underground Mining and Open cast Mining. Comparison of Underground and Surface Mining. Mining method of Coal and Non-coal deposits.

**Unit II**

Boring : Principles of boring ; selections of sites for boreholes ; surface layout ; method of Percussive Drilling (solid hollow and ropes), Rotary Drilling (diamond, chilled shot, clay and other system), details of equipments, properties of drilling mud, interpretations of bore hole data, bore hole logging, maintenance of records , Difficulties in boring, Fishing tool and their uses.

**Unit III**

Sampling: Sampling in mining geology. Different types of samples, and their collection, Treatment and handling of samples, precautions, Ore reserves estimation, Different types of Reserves and their estimation, Calculation of grade and tonnage, Methods for averaging of assays.

Explosive and Blasting : Types and Explosives, Properties of Explosives, Modern Explosives, Principles of Blasting, Blasting Practice : Surface and Underground Blasting.

**Unit IV**

Engineering properties of rocks. Physical characters of building stones. Role of Engineering Geology in construction of Dam, Bridge and tunnels. Types and methods of tunnels.

**Unit V**

Aseismic designing — seismicity in India and earthquake-resistant structures. Problems of groundwater in engineering projects; Case studies of Indian dams: Bhakra, Tehri, and Idduki Dams; Site selection for the construction of roads in hilly terrains.

**PRACTICAL:**

**Geol. 405: Industrial Minerals, Mineral fuels, Mineral Prospecting and Exploration**

1. Physical properties, mode of occurrence and genesis, economic use and Indian location of important metallic minerals in India and their uses: mica, asbestos, pyrite, barites, gypsum, bentonite, garnet, corundum, kaynite, sillimanite, graphite, talc, fluorite, beryl, zircon rock phosphate quartz, feldspar,Diamond, Lime \stone, Marble, Sandstone, granite and coal.
2. Occurrence and Indian location of important industrial minerals, coal and petroleum deposits.
3. Identification and physical properties of fuel minerals.
4. Exercises on mineral exploration.

**Geol. 406: Geoinformatics, Geoenvironment, Mining and Engineering Geology:**

 1. Understanding of Tool and Techniques to study with areal photographs and imagery.

 3. Study of topography and Geomorphological features with aerial photos and imagery.

 4. Study of structural features with aerial photos and imagery .

 5. Study of rock types with aerial photos and imagery.

 6. Ore reserves estimation

 7. Megasopic properties of industrial and energy minerals.

 8. Engineering properties of building and dimensional stones.

 9. Geological Study Tour/ camp\* on Mining Geology

\***Note**: Mining Tour/ Camp is an essential part of the Syllabus.

**Geol. 407 (Any one): Skill Development Course**

1. **Groundwater**
2. Science of Groundwater occurrence. Water cycle.
3. Well hydraulics and Exploration of Groundwater.
4. Chemical quality of Groundwater for various application.
5. Conservation of groundwater, artificial recharge.
6. Legislations and management of groundwater sources.
7. **Geohazards**

Study of Geohazards: Earthquake, Volcanoes, Land sliding, Floods etc.