

**Institute of Earth Sciences  
Department of Geology  
Bundelkhand University Jhansi**



**Ordinance and Syllabus for  
B.Sc. (Hons) Geology Program  
(National Education Policy 2020)**

**Academic Session – 2022-23 onwards**

A handwritten signature in blue ink, consisting of a stylized 'S' followed by a checkmark-like flourish.

# ORDINANCE FOR BACHELOR IN HONOURS (SEMESTER SYSTEM) PROGRAMME OF ARTS, SCIENCE & COMMERCE

## 1. INTRODUCTION

### Preamble

This ordinance governs all the rules and regulations as per the NEP 2020 for under-graduate programs B. A. (Hons), B.Sc. (Hons) and B. Com (Hons) running in the Bundelkhand University, Campus Jhansi from 2022 onwards. This ordinance supersedes all the previous relevant ordinances, rules and regulations.

### Duration

Bundelkhand University has adopted the semester system in Undergraduate Honours courses as per directives of Department of Higher Education, Uttar Pradesh Government to accelerate the teaching-learning process and enable vertical and horizontal mobility in learning from academic session 2022- 23 onwards.

The programme duration shall be of three academic years, i. e. six semesters. In case a student (s) exit (s) from the programme after completion of first year (2 semesters), he/she may take exit from the programme with a certificate and after completion of two years (4 semesters) he/she may exist with a Diploma. A student will be awarded Bachelor in Honour Degree after the completion of three academic years (6 semesters). A student shall be allowed to take re-entry at the next level after his/her exit at any time within seven years from the date of joining the course.

However, the students shall be permitted to complete the programme requirements within a maximum of seven years from the date of admission to the first year of the under graduate (Hons) programme.

### Eligibility of Admission

- Candidate, who wishes to seek admission in a course of study prescribed for an undergraduate degree in Hons program of the University, shall be admitted to campus or an affiliated college unless he/ she has:

candidate must pass the Intermediate Examination of the board of High school and Intermediate Education, Uttar Pradesh or of any other Indian Board incorporated by any law in force at the time of admission.

or

Passed any other examination recognized by the University as equivalent there to.

- The date of admission shall follow the University academic calendar.

### Choice of Honours Subject and Course Structure

- University shall admit students as per the eligibility criteria and availability of seats decided by the university from time to time.
- A student willing to take admission to the first year of Higher Education program after 12th class, will have to choose a Faculty (Science, Arts or Commerce, etc.) depending on the number of seats available and eligibility criteria.
- Student(s) shall select any one Honours specific subject for all the three years (first, second, third, fourth, fifth and sixth semesters) as discipline specific core (DSC) i. e. Major I & II (table 1) and shall continue to study any one discipline specific elective (DSE) as major III subject along with Hons subject in first two years (as given in table 2).
- Student(s) shall select a generic elective (GE) paper as **Minor-1** from any other faculty (except own faculty) or can choose interdisciplinary subjects in the first two years. Minor –I elective is a course of pool of subjects/papers shown in table 3a and 3b (Minor-1). The student shall select one subject in the first year (first semesters) from the pool course and another subject in second year from the pool (Table 3). Minor –I shall be one paper of 4/5/6 credits and is not as full subject. No pre-requisite shall be required for this. The student may choose Minor –I from the mentioned table 3.

- Student(s) shall select ability enhancement course (AEC) or skill enhancement course (SEC) known as **Minor-II (Vocational/skill development course)** from the course of pool subjects mentioned in table 4 (Minor -II). Candidate shall choose any one paper in each semester of his/her interest in the first and second year (one in each semester i.e., first, second, third and fourth semesters) from the pool of table 4. Each course of SEC comprises of theory (1 credit) and training (2 credits). Ratio of theory and Skill component in the syllabus will be 40:60 respectively. Theoretical evaluation will be carried out by department and training evaluation will be done by skill partner/department.
- The University shall offer value added courses as Co-curricular paper/subject known as Minor-III. This value-added course (VAC) is related to induction of multidisciplinary education by embedding knowledge within the framework of NEP. The student shall need to take one paper in each semester of first, second and third year of under graduate Hons programme. This is only qualifying paper/papers. One co-curricular course will be offered in each semester as Minor -III in the sequence given below.
  1. Food and Nutrition (Semester-I)
  2. First Aid and Health (Semester-II)
  3. Human Values and Environment Studies (Semester-III)
  4. Physical Education and Yoga (Semester-IV)
  5. Analytic Ability and Digital Awareness (Semester-V)
  6. Communication Skills and Personality Development or Character Building (Semester-VI)
- Marks of practical's related to DSC, DSE and SEC papers will be uploaded by the by Head of Department on the examination portal and will be mentioned in the marks sheet. It shall be mandatory for the department to maintain the related data (records) till the maximum duration of the course of the concerned batch.
- Department and skill partner may jointly issue a certificate to the student additionally.
- New skill enhancement courses shall be developed by Bundelkhand University after necessary approval from relevant academic bodies. Existing courses developed by UGC/NSQF/ Skill development Council/ others may be given preference.
- Credit distribution in Hons courses is as below:  
1 credit (theory)= 15 hours 1. credit (training)= 30hours

Courses can be of individual nature or progressive nature.

NOTE: These co-curricular papers must be essentially passed with 40 percent marks. The grade on the basis of marks will be entered in the grade sheet but will not be counted in calculation of CGPA.

## Semester Structure and Distribution of credits in undergraduate Hons program

### Table- 1

SEM -I							
SEM -I	Major I & II (DSC): Credit 4/5/6	Major-III (DSE): Credit4/5/6	Minor-I(GE) Credit4/5/6	Minor-II (SEC/AEC) credit 3	Minor-III (VAC) qualifying	Industrial / training Credit 4	ΣCredits
	DSC-1 TH-I DSC-2 TH-II	DSE-I TH-1	GE 1 -TH-1	SEC-1-TH-1	VCA-1 TH-1		25
SEM-II							
SEM -II	DSC-3TH-1 DSC-4 TH-II	DSE-I TH-1		SEC2-TH-1	VCA-2 TH-1		19
CERTIFICATE in Faculty							46/62
SEM -III	DSC-5 TH-I DSC-6 TH-II	DSE-I TH-1	GE -2 TH-1	SEC-3TH-1	VCA-3TH-1		25
SEM -IV	DSC-7 TH-I DSC-8 TH-II	DSE-I TH-1		SEC-4TH-1	VCA-4TH-1		19
DIPLOMA in Faculty							92/62
SEM -V	DSC-9 TH-I DSC-10 TH-II DSC-11TH-III	-	-		VCA-5TH-1		18
SEM -VI	DSC-12 TH-I DSC-13 TH-II DSC-14 TH-III	-	-		VCA-6TH-1	Industrial / Training program	22
BACHELOR in Geology (Hons)....							/132

#### Explanation of Table

DSC            (4+2=6) Credit (Subject with practical)            6: Credit (Subject without practical)

DSE            (4+2=6) Credit (Subject with practical)            6: Credit (Subject without practical)

GE             4 Credit

SEC/AEC      3 Credit

Training      4 Credit

VAC            Qualifying

**Table -2** List of Honours Course in Campus

<b>Major Courses for Bachelor in Honours in Science –Major I and II) for Arts, commerce and Science (DSC)</b>	
1	Environmental science
2	Biotechnology
3	Biochemistry
4	Microbiology
5	Biomedical sciences
6	Life sciences
7	Forensic science
8	Earth science
9	Food technology
10	B Com
11	Hindi
12	Education
13	English
14	Social work
15	Economics

**Table 3a:** list of Science discipline Subject for DSE. Select anyone as Major III

<b>Major –III for Science (DSE)</b>	
1	Environmental science
2	Biotechnology
3	Chemistry
4	Mathematics
5	Home science
6	Zoology
7	Forensic science
8	Earth Sciences
9	Food Science technology
10	Agriculture microbiology
11	Agriculture biotech
12	Biochemistry
13	Physics
14	Botany

**Table 4** list of Subject of GE / Minor –I for Science Faculty

Select one subject for each year and other subject for second year from interdisciplinary or from other faculty.

	Subject	Other faculty	Minor -I (GE)
1	Agro forestry		Interdisciplinary
2	Horticulture		Interdisciplinary
3	Disaster management		Interdisciplinary
4	Fundamentals of entrepreneurship		Interdisciplinary
5	Business economics		Commerce
6	Modern political thoughts		Arts
7	Indian national movement		Arts
8	Gandhian philosophy		Arts
9	Tribal culture		Arts
10	Social security		Arts
11	Indian arts and culture		Arts
12	Village and Panchayatiraj		Arts
13	Manuscript conservation		Arts
14	Traditional knowldge in Indian medicine and medicinal plants		Interdisciplinary
15	Alternative medicine		Science
16	Basics of electronic media		Science
17	Tools and techniques in bioinformatics		Science
18	Urban development & economic growth		Interdisciplinary
19	Non-conventional energy resource		Interdisciplinary
20	Cyber crime (cryptography)		Interdisciplinary
21	Dirking water quality assessment		Interdisciplinary
22	Water conservation and river linking		Interdisciplinary
23	Energy and environment		Interdisciplinary
24	Hindi shahitya ka		Interdisciplinary
25	History of English literature		Interdisciplinary

**Table 5** list of Skill enhancement courses for science, commerce and Arts disciplines. Select one course in each Semester for first two years (Semester –I, II, III and IV)

(SEC/AEC) or Minor –II	
1	Hand writing document examination
2	Vedic math
3	Astrology
4	Gems and dimensional stone
5	Computer hardware & networking
6	Soft skill
7	Tour guide and heritage
8	Hospital management0
9	Clinical diagnostics
10	Bakery and value added Production
11	Telly
12	Food processing
13	Industrial microbiology
14	Photography
15	Chemical sale marketing
16	Seed technology
17	Rural development
18	Community health
19	Health and hygiene
20	Organic farming

**Table 6:** list of Co-curricular courses as Minor III (Value added Course) common for science, commerce and Arts disciplines. Select one course in each Semester for three years (Sem –I, II, III,IV,V and VI)

SN	Course paper	Semester
1	Food and Nutrition	(Semester-I
2	First Aid and Health	Semester-II
3	Human Values and Environment Studies	Semester-III
4	Physical Education and Yoga	Semester-IV
5	Analytic Ability and Digital Awareness	Semester-V
6	Communication Skills and Personality Development or Character Building	Semester-VI

## SEMESTERS

An academic year is divided into two semesters. The Odd semester may be scheduled from July to December (6 months) and Even semester from January to June (6 months) as decided by University from time to time.

### 3. ATTENDANCE

The expression "a regular course of study" wherever it is used in these Ordinances, means attendance of at least 75% of the lectures and other teaching in campus / affiliated college in the subject for the examination at which a candidate intends to appear and at such other practical work (such as work in a laboratory) as is required by any Statute, Ordinance or Regulation in force for the time being in the University.

A shortage up to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the Principal of the college/ Head of the Department (in case of University Campus) concerned.

A further shortage up to 10% may be condoned only by the Vice- Chancellor on the specific recommendation of the

Principal of the college/Head of the Department concerned (in case of University Campus).

#### 4. EXAMINATIONS

1. There shall be examinations at the end of each semester as, for odd and even semesters in accordance with the academic calendar of the university. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations up to the maximum duration of the course.
2. A candidate should get enrolled/registered for the first semester examination and is mandatory. If enrolment/ registration is not possible owing to shortage of attendance / rules prescribed OR belated joining or on medical grounds, such students shall not be permitted to proceed to the next semester. Such students shall re-do the first semester in the subsequent term of that semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she has successfully completed the first semester.
3. It shall be mandatory for the student(s) to register for examination in each and every semester (i.e. to fill up the examination form with the requisite fee). If a student fails to register for the examination in any semester, he or she shall not be allowed to appear in that semester as a back paper student. Such student(s) shall appear in the (next) subsequent examination of that semester.

#### 5. EVALUATION

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidated at the end of course. The evaluation must be continuous and holistic and should be based on following parameters:

- i. Academic assessment
- ii. Skill assessment
- iii. Physical assessment
- iv. Personality assessment
- v. Extra-curricular assessment

#### 5.1 THEORY PAPER

Semester Examinations shall be conducted by the university as mentioned in the academic calendar. The Question paper will be set by the examiners appointed by the Vice Chancellor based on the recommendation of the board of studies. The pattern of the question paper shall be as given in annexure II.

- i. Internal Assessment (C.I.A.) – 25% weightage of a course
  - Test/ Mid-Term Assessment - 10 marks
  - Term paper/Presentation on given project/assignment - 10 marks
  - Attendance/activities – 05 marks
- ii. End Semester Exam (External examination) – 75% weightage of course

#### 5.2 PRACTICAL PAPER

Practical examinations will be conducted by the examiners appointed by the Vice Chancellor on the recommendations of the Board of Studies. Each student has to present the practical records.

- i. Internal Assessment (C.I.A.) – 25% weightage of a course
  - Test/ Mid-Term Assessment - 10 marks
  - Term paper/Presentation on given project/assignment - 10 marks
  - Attendance/activities – 05 marks
- ii. End Semester Exam (External examination) – 75% weightage of a course

#### 6. MINIMUM PASSING STANDARD



1. The minimum passing standard for combined external and internal examinations for each subject/paper shall be 45%, i. e. 45 out of 100 marks for theory and practical courses. The minimum passing standard for Aggregate in a semester end Examination shall be 45%.
2. Continuous Internal Assessment (CIA) shall be ensured by the principal of the colleges / HODs for the Campuses courses. The principal of the colleges / HODs of the Campus shall provide the marks of the same to the university and it shall be mandatory to maintain the records of the same till the maximum duration of that course.
3. The internal assessment, field training and practical examination awards of a student who fails in any semester examination shall be carried forward to the next examination.
4. It shall be mandatory for a student to secure minimum 45% marks (i.e. 34/75) in the theory and practical paper separately.

#### 7. Exit Option:

The minimum credit to be earned by a student per semester is 23 credits and the maximum is 31 credits. However, students are advised to earn 23 credits per semester. This provision is meant to provide students the comfort of the flexibility of semester-wise academic load and to learn at his/her own pace. However, the mandatory number of credits have to be secured for the purpose of award of Undergraduate Certificate/ Undergraduate Diploma/ Appropriate Bachelor's Degree in the field of Study/Discipline, to a student who chooses to exit at the end of even semesters (details provided in the table below).

Sl. No	Type of Award	Stage of exit	Mandatory credits to be secured for the award
1	Undergraduate Certificate in the field of study/discipline	After successful completion of Semester II	46
2	Undergraduate Diploma in the field of study/discipline	After successful completion of Semester IV	92
3	Bachelor of Honours of core course of study	After successful completion of Semester VI	132
4	Bachelor of Honours of core course of study with research	After successful completion of Semester VIII	

#### 8. PROVISION FOR BACK PAPERS AND EX-STUDENTS

A Back Paper (B.P.) candidate shall be promoted to next semester. The back paper facility in a semester provides promotion to the next semester and another opportunity to obtain a minimum of the pass marks assigned for an individual paper or in the aggregate. Following category of students of Hons program of Bundelkhand University shall be eligible for back paper facility as under,

1. A student shall be required to pass in minimum two subject papers in each semester. However, at the end of each year, it shall be mandatory for a student to pass in at least two subject's papers and minor paper otherwise he/she shall be deemed as failed and will be treated as a year back / ex- student.
2. Students shall get the attempts to appear in the Back paper examination in the subsequent odd /even semester till the maximum duration of the said course.
3. Special back paper examination shall be held only for regular students of the final year of PG course.
4. The candidate who fails in more than three of the total papers, will be deemed as failed. These candidates can appear only in subsequent examination of that semester as Ex- Students.

## 9. PROMOTION RULES

### 9.1 Semester Course & Examination:

The students who have taken admission in any post-graduation programme in a session and who have put in the minimum percentage of attendance for appearing at the Examination, presented himself/herself for internal assessment and have filled in the examination form in time for appearing at the End Semester Examination shall be allowed to appear at the respective examinations.

### 9.2 Declaration of results

After appearing in the Examination of both the semesters in a particular year, the student can be put in the following categories in the context of declaration of the results of the Semester Examination:

- 1) Passed
- 2) Promoted with Back Paper(s)
- 3) Failed

### 9.3 Promotion to next Semester:

- 1) All students under category Passed and promoted with back papers shall be promoted to the next Semester.
- 3) "Failed" students may clear their UNCLEARED courses in subsequent examinations as ex-students.
- 2) Students promoted with back papers shall clear their back papers in subsequent examinations

A student who has failed in a course shall get two more chances to clear this course subject to the maximum duration for passing the course. Further, each candidate shall have to clear all the courses within the maximum period of seven years from the date of his/her latest admission.

A candidate who has qualified for the Degree shall be placed in the First / Second Division as per following table:

## 10. COMPUTATION OF SGP AND CGPA

The guidelines formulated by Bundelkhand University shall be followed in order to bring uniformity in evaluation system of every CBCS based Course and computation of the SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average) based on students' performance in examination. The number of core (DSC), elective (DSE), open elective papers (GE and SEC) and foundation papers and the required credit for each paper shall be formulated by respective Board of Studies (BOS) and faculty board. For the purpose of computation of work load the UGC proposed mechanism is adopted i.e. one credit=1 Theory period of one hour duration, 1 credit= One Tutorial period of one hour duration, 1 credit=1 Practical period of one hour duration. The credit(s) for each theory paper/practical/tutorial/dissertation will be as per the respective Board of Studies of departments.

Letter Grade	Numerical grade
O (outstanding)	10
A+ (Excellent)	9
A (very good)	8
B+(Good)	7
B (Above average)	6
C (Average)	5
D (Satisfactory)	4.5
F(Fail)	Below 4.5
Ab (Absent)	0

The minimum passing marks shall be 45% of the maximum marks as prescribed in the University Examination and 45% of marks in the aggregate marks in the subject including internal / sessional marks.i.e. Minimum Passing Grade is "D".

A student who obtains Grades "O" to "D" shall be considered as PASSED. If a student secures "F" grade, he/she shall be considered as FAILED and shall have to re-appear in the examination. It is mandatory for a student to earn the required SGPA as in each semester. If a student is not able to secure 45% / D grade in any theory / practical / internal / sessional / viva-voce / internship / project examination, the awarded grade point shall be ZERO (0).

10.1 The University, adopts absolute grading system where in the marks are converted to grades, and every semester results will be declared with semester grade point average (SGPA) and year result will be declared with year grade point average (YGPA). The Cumulative Grade Point Average (CGPA) will be calculated at the end of final semester. The grading system except pharmacy department will be with following letter grades and grade points scale as given below:

Level	Outstanding	Excellent	Very Good	Good	Above Average	Average	Fail
Letter Grade	O	A+	A	B+	B	C	F
Grade Points	10	9	8	7	6	5	0
Score (Marks) Range (%)	≥90 (90-100)	<90, ≥80 (80-89.99)	<80, ≥70 (70-79.99)	<70, ≥60 (60-69.99)	<60, ≥50 (50-59.99)	<50, ≥45 (45-49.99)	<45 (0-44.99)

1.1 A student obtaining Grade "F" shall be considered failed and will be required to reappear in the examination. Such students after passing the failed subject in subsequent examination / will be awarded with grade respective of marks he/she scores in the subsequent examination/s.

1.1 The University has the right to scale/moderate the theory exam / practical exam / internal exam / sessional marks of any subject whenever required for converting of marks into letter grades on the basis of the result statistics of university as in usual practice, i.e. marks obtained in decimal will be converted in nearest integer.

## 11. CONVERSION OF GRADES IN TO PERCENTAGE

1.2 Conversion formula for the conversion of CGPA into Percentage is

$$\text{CGPA Earned} \times 10 = \text{Percentage of marks scored.}$$

Illustration: CGPA Earned 8.2  $\times 10 = 82.0\%$

## 2. AWARD OF DIVISION

Division shall be awarded only after the final semester examination based on integrated performance of the student for all the semesters as per following details.

2.1 A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secure as a CGPA of 8.0 and above shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS**.

2.2 A student who qualifies for the award of the degree securing "B" or above grades in all subject pertaining to all semesters, and in addition secures a CGPA of 7.0 and above shall be declared to have passed the examination in **FIRST DIVISION**.

**2.3** A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secures a CGPA of 5.0 and above shall be declared to have passed the examination in **SECOND DIVISION**.

## **12. UNFAIR MEANS:**

Cases of unfair means in the End Semester Examinations and Mid-Term Tests shall be dealt as per the rules laid by the University.

### **Note:**

1. Those students who are NOT eligible for promotion to next year shall have to reappear in the coming examination as ex-students. However, the marks of internal assessment shall be carried forward in such cases.
2. Scrutiny facility and Challenge evaluation facility shall be available for those students who want to improve their grades.

### **Programme outcomes(POs):**

- ✓ The 4-Year B.Sc. programme with Geology as a Major Subject is designed with the objective of educating students for success as a geo-scientist having employability in government sector, public sector, private sector, research institutes, or further qualifying JAM, NET, GATE or other national examinations so as to pursue further study including Doctoral studies.
- ✓ The students are likely to get regular placements in GSI, ONGC, CIL, MECL etc. apart from reputed private organizations related to industries, mineral exploration & mining industries and organizations working in the field of exploration using remote sensing & GIS techniques.
- ✓ The holistic development of students helps them in getting placements in various national institutes like BSI, WIHG, PRL, NGRI etc.

### **Programme Specific Outcomes(PSOs):**

- ✓ During the proposed eight semesters, students will be able to identify, examine and understand the different geological materials,
- ✓ Geological Setting and associations.
- ✓ The students with their robust foundation learn to interpret various geological maps, prepare cross-sections, geologic field mapping, understanding of stratigraphic concepts, geological successions of Precambrian to Recent rocks, sediments and their lateral and vertical disposition; rock identification on the basis of minerals composition and basic physical, megascopic and microscopic characters.
- ✓ They learn about the origin and evolution of landforms, fossil identification up to generic level, their evolution and mode of life, in-depth understanding of the sedimentary structures and facies analysis, various rock types based on petrological thin sections, palaeoclimatic and palaeogeographic changes, origin and distribution of economic mineral and energy resources of the country etc.
- ✓ The students also develop basic aptitude and understanding of the environmental issues related to planet earth.
- ✓ Geological excursion would be an important component of the 4-year B.Sc. Programme in Geology for laying a robust foundation for the budding geologists. Students will get exposure of actual rocks during geological excursion. Students will learn about data collection, measurements and their interpretations.
- ✓ Exploration for economically useful Earth material is another important outcome of the present program.

- ✓ During the Major Project, students will take-up a geological problem utilizes theoretical knowledge along with analytical or experimental approach to solve it. The students will have to defend their Project outcome in an open forum.
- ✓ The course 'Research Methodology' has been designed to make the students learn the basics of research work, to develop research skills and to encourage them to pursue research in various fields of Geology.



# Department of Geology, Bundelkhand University

(Under National Education Policy-2020)

Syllabus for B. Sc. (Hons.) Geology

Year wise Structure of B.Sc.(Hons.) Geology

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits
First YEAR	I	DSC-I	General Geology and Physical Geology	Theory	4
		DSC-II	Mineralogy, Crystallography and Optical Mineralogy	Theory	4
			Practical For DSC-I	Practical	2
			Practical For DSC-II	Practical	2
		DSE	Elective: one paper from Table 3a	Theory	4
			Practical for DSE	Practical	2
		GE	Elective: one paper from Table 4	Theory	4
		SEC	Elective: one paper from Table 5	Theory	3
	VAC	Elective: one paper from Table 6		qualifying	
			<b>Total credit in Semester-I</b>		<b>25</b>
First YEAR	II	DSE-III	Structural Geology and Tectonics	Theory	4
		DSE-IV	Petrology	Theory	4
			Practical For DSC III	Practical	2
			Practical For DSC IV	Practical	2
		DSE	Elective: one paper from Table 3a	Theory	4
			Practical for DSE	Practical	2
		SEC	Elective: one paper from Table 5	Theory	3
		VAC	Elective: one paper from table 6	Theory	qualifying
			<b>Total credit in Semester-II</b>		<b>21</b>
			<b>CERTIFICATE in Faculty</b>		<b>46</b>
Second YEAR	III	DSC-V	Palaeontology	Theory	4
		DSC-VI	Stratigraphy	Theory	4
			Practical for DSC V	Practical	2
			Practical for DSC VI	Practical	2
		DSE	Elective: one paper from Table 3a	Theory	4

			Practical for DSE	Practical	2
		GE	Elective: one paper from Table 4		4
		SEC	Elective: one paper from Table 5		3
		VAC	Elective: one paper from 6		qualifying
			<b>Total Credit in Semester III</b>		<b>25</b>
Second YEAR	IV	DSC-VII	Economic Geology	Theory	4
		DSC-VIII	Hydrogeology	Theory	4
			Practical for DSC VII	Practical	2
			Practical for DSC VIII	Practical	
		DSE	Elective: one paper from Table 3a		4
			Practical for DSE	Practical	2
		GE	Elective: one paper from Table 4	Theory	4
		SEC	Elective: one paper from Table 5	Theory	3
		VAC	Elective one paper from Table 6	Theory	qualifying
			<b>Total Credit in Semester IV</b>		<b>21</b>
<b>DIPLOMA</b>					<b>92</b>
Third	V	DSC-IX	Environmental Geology	Theory	4
		DSC-X	Mineral Exploration and Mining Engineering	Theory	6
		DSC XI	Geochemistry	Theory	4
			Practical for DSC IX	Practical	2
			Practical for DSC XI	Practical	2
		VAC	Elective any one paper from Table 6	Theory	qualifying
			<b>Total credit in Semester V</b>		<b>18</b>
Third	VI		Field Training	Field Training	4
		DSC-XII	Remote Sensing and GIS Applications	Theory	4
		DSC-XIII	Engineering Geology	Theory	4
		DSC-XIV	Fuel Geology	Theory	6
			Practical for DSCXII	Practical	2
			Practical for DSCXIII	Practical	2
		VAC	Elective one paper from Table 6	Theory	qualifying
<b>BACHELOR in GEOLOGY (Hons)</b>					<b>132</b>

Programme/Class: <b>Certificate</b>		Year: <b>First</b>	Semester: <b>First</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>General Geology and Physical Geology</b>	
Course outcomes: After completing the course, student Will learn origin of solar system and Earth Will understand internal structure of Earth Will understand role of weathering agents and action of geological agents			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: 45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0			
Unit			No. of Lectures
I	Introduction to Geology and its scope, Earth and Solar system: origin, size and shape of Earth,		7
II	Age of Earth, Internal Structure and composition of Earth,		7
III	Isostasy and Mountain building processes		7
IV	Basic concepts of Geomorphology, Physiography, Physiographic Division of India		7
V	Weathering: types, factor. Erosion, transportation and deposition by wind and their related landforms		9
VI	Erosion, transportation and deposition by glaciers and rivers, and their related landforms;		9
VII	Erosion, transportation and deposition by lakes and oceans, and their related landforms;		7
VII	Erosion, transportation and deposition ground water and their related landforms		7
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. The Blue Planet: An Introduction to Earth System Science – B.J. Skinner and S.C. Porter. 1995, John Wiley &amp; Sons, Inc. 493p.</li> <li>2. Introduction to Physical Geology – G.R. Turk. 1998, Saunders College Publishers, Fort Worth. 371p.</li> <li>3. Processes that Shape the Earth – D.M. Thompson. 2007, Infobase Publishing NY. 116p.</li> <li>4. Physical Geology – L.D. Leet, S. Judson and M.E. Kauffman, (1982). Prentice-Hall Inc. 629p.</li> <li>5. Holme's Principles of Physical Geology – P.M. V.L.D. Duff, Fourth Edition (1993). Stanley Thornes (Publishers) Ltd.</li> </ol>			



Programme/Class: <b>Certificate</b>		Year: <b>First</b>	Semester: <b>First</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>Mineralogy, Crystallography and Optical Mineralogy</b>	
Course outcomes: After completing the course, student Will learn the mineral and its types Will understand the crystal formation, form and occurrence Will learn formation of mineral groups and resource			
Credits: 4		Core: <b>Compulsory</b>	
Max. Marks: 25+75		Min. Passing Marks: 45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0			
Unit	Topics		No. of Lectures
I	Basic idea about crystal, crystal growth and crystallisation; Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations;		7
II	Crystal forms; Habit and classification; Preliminary idea about various types of projection, Crystal aggregate: Twinning and common twin laws;		7
III	Symmetry and forms of Cubic (Galenite type, Pyrite type and Tetrahedrite type), and Tetragonal (Zircon type) Crystal Systems		8
IV	Symmetry and forms of Hexagonal (beryl type and calcite type), Orthorhombic (Barytes type), Monoclinic (Gypsum type), and Triclinic (Axinite type) Crystal Systems		8
V	Definition of mineral; Atomic bonding; Physical properties of minerals: colour, lustre, form, isomorphism, pseudomorphism, polymorphism, hardness, fracture, cleavage, specific gravity, and characters based on heat, electricity and magnetism;		8
VI	Physical properties, chemical composition, occurrences, and uses of minerals belonging to the Silica and Feldspar families, and clay minerals		7
VII	Physical properties; chemical composition, occurrences, and uses of Pyroxene, Olivine, Amphibole, Mica and Garnet Group,		10
VIII	Nicol prism; Optically isotropic and anisotropic minerals; Polarisation of light; Optical properties of minerals under polarized light and crossed polars: refractive index, pleochroism, relief, twinkling, birefringence, interference colours, extinction and twinning;		6

**Suggested Readings:**

1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication.
2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication
3. Mason, B., 1986. Principles of Geochemistry. 3<sup>rd</sup> Edition, Wiley New York.
4. Rollinson H. 2007 Using geochemical data - evaluation. Presentation and interpretation. 2<sup>nd</sup> Edition. Publisher Longman Scientific & Technical.
5. Walther John, V., 2009 Essentials of Geochemistry, student edition. Jones and Bartlett Publishers.
7. Albarède, F., 2003. An introduction to geochemistry. Cambridge University Press.

**Practical – I:**

Programme/Class: <b>Certificate</b>		Year: <b>First</b>	Semester: <b>First</b>
Subject: <b>Geology</b>			
Course Code:	Course Title: <b>Practical General Geology and Physical Geology + Mineralogy, Crystallography and Optical Mineralogy</b>		
Course outcomes: After completing the course, student will see and feel a natural mineral Will learn to identify the mineral in hand specimens			
Credits: 2+2		Core: <b>Compulsory</b>	
Max. Marks: (25+75) for each		Min. Passing Marks: 40	
<b>Unit</b>	<b>Topics</b>		<b>Lectures</b>
	Study of geomorphological models, Study of Minerals in hand specimens, Moh Hardness Scale Study of minerals and texture in thin section, Study of Crystal Models: Element of Symmetry, Forms		30+30
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication.</li> <li>2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication</li> <li>3. Phillips, F. C., 1963. An introduction to crystallography. Wiley, New York</li> <li>4. Nesse, D. W., 1986. Optical Mineralogy. McGraw Hill.</li> <li>5. Kerr, B. F., 1995. Optical Mineralogy 5th Ed. McGraw Hill, New York.</li> </ol>			

Programme/Class: <b>Certificate</b>		Year: <b>First</b>	Semester: <b>Second</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>Structural Geology and Tectonics</b>	
Course outcomes: After completing the course, student -Will understand the genesis, types and nomenclature of structural features imprinted in earth's crust -Will learn the Interpretation of deformed structures.			
Credits:4		Core: Compulsory	
Max.Marks: 25+75		Min.PassingMarks: 40	
Unit	Topics		No. of Lectures
<b>I</b>	Introduction to structural geology; Study of outcrop; Identification of bedding; Measurement of dip, strike and thickness of beds.		7
<b>II</b>	Unconformity: classification recognition and geological significance. Top and Bottom of Beds		8
<b>III</b>	Simple deformational structures: Fold morphology, nomenclature, their geometrical and genetic classification and recognition in field.		7
<b>IV</b>	Nomenclature; Geometric and genetic classification of Faults (Normal, reverse and strike-slip faults);		8
<b>V</b>	Recognition of faults in the field; Effects of faults on folded beds		8
<b>VI</b>	Outlier and Inlier, Window, Klippe and Nappe Onlap and Offlap;		7
<b>VII</b>	Joint and its classification, Planar and Linear structures		7
<b>VII</b>	Basic concepts of Plate-Tectonics; Continental Plate, Continental Drift, and Sea Floor Spreading		8
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. Bailey, B., n1992. Mechanics in Structural Geology, Springer.</li> <li>2. Davis, G.H. and Reynolds, S.J., 1996. Structural Geology of rocks and regions, John Wiley. And Sons.</li> <li>3. Ghosh, S.K., 1993. Structural Geology: Fundamentals, and modern developments, Pergamon Press.</li> <li>4. Leyson, P. R. and Lisle, R.J., 1996. Stereographic projection techniques in structural geology, Cambridge University Press.</li> <li>5. Passhler, C. and Trouw, R.A. J., 2005. Microtectonics. Springer, Berlin.</li> <li>6. Pollard, D.D. and Fletcher, R.C., 2005. Fundamentals of structural geology, Cambridge University Press.</li> <li>7. Ramsay, J.G. and Huber, M.I., 1983. Techniques of Modern Structural Geology: vol. I &amp; II. Academic Press.</li> <li>8. Ramsay, J.G., 1967. Folding and Fracturing of Rocks, McGraw-Hill Book Company, New York.</li> <li>9. Rowland, S. M., Duebendorfer, E. and Schiefelbein, I. M., 2007. Structural analysis and synthesis: a laboratory course in structural geology, Balckwell pub.</li> <li>10. Suppe, J., 1985. The Principles of Structural Geology, Prentice-Hall, Inc., New Jersey,.</li> <li>11. VanderPluijm, B.A. and Marshak, S., 2004. Earth structure: an introduction to structural Geology.</li> </ol>			

Programme/Class: <b>Certificate</b>		Year: <b>First</b>	Semester: <b>Second</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>PETROLOGY</b>	
<b>Course outcomes:</b> After completing the course, student Will learn to identify rock types and their mineralogical composition. Will learn texture, structure found within the rock Will understand the role of temperature and pressure information of rocks Understand stratigraphy and sedimentation history of different sedimentary basins of India Will understand the process of sedimentation and rock formation			
Credits: 3		Core: <b>Compulsory</b>	
Max. Marks: 25+75		Min. Passing Marks: 45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0			
Unit	Topics		No. of Lectures
<b>I</b>	Igneous rocks, their structures and forms; geological occurrences. Classification, texture and microstructure of Igneous rocks,		12
<b>II</b>	Magma and its character, Origin and crystallization of magma. Binary system, Bowen Reaction principle,		6
<b>III</b>	Texture, Structure, mineral composition and mode of occurrence of granite, granodiorite, diorite, pegmatite, rhyolite, syenite, trachyte, gabbro, basalt, dolerite, phonolite, monzonite, dunite, peridotite rocks.		8
<b>IV</b>	Nature and origin of sedimentary rocks, Texture, structure of sedimentary rocks.		8
<b>V</b>	Classification of sedimentary rocks; Sedimentation and environments.		7
<b>VI</b>	Mineralogical composition, texture and geological occurrences of shale, sandstone, conglomerate, breccia, limestone, dolomite rocks.		8
<b>VII</b>	Important metamorphic texture, nomenclature of metamorphic rocks, metamorphic agents, grade and zone of metamorphic rocks, ACF, AKF and AFM diagrams,		8
<b>VIII</b>	Texture, structure and significance of important metamorphic rocks: schist, gneiss, hornfels, phyllite, Blue schist, eclogite, charnockite, khondalite, amphibolite and marble.		9
<b>Suggested Readings:</b> 1. Cox, K.G., Bell, J.D. and Pankhurst, R.J. 1979. Interpretation of igneous rocks. George Allen and Unwin, London. 2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman. 3. Anthony R. Philpotts and Ague, J.J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge. 4. Winter, J.D. 2001. Igneous and Metamorphic Petrology. Prentice Hall. 5. Gautam Sen, 2014. Petrology: Principles and Practice. Gautam Sen (Springer). 6. Best, M.G. 2013. Igneous and Metamorphic Petrology. Wiley Blackwell.			

**Practical –II:**

Programme/Class:	Year: <b>First</b>	Semester: <b>Second</b>
Subject: <b>Geology</b>		
CourseCode:	CourseTitle: <b>Practical: Structural Geology and Tectonics+ Petrology</b>	
Courseoutcomes: After completing the course, student Will be able to interpret the geological maps Will able to measure the geological data from the field		
Credits: 2		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks: 45
Total No.ofLectures-Tutorials-Practical(inhoursperweek): L-T-P:0-0-2		
Unit	Topics	No. of Lectures
	Problemson dip, strike; Contour maps and completion of outcrops; study and Interpretation of topographical maps; Use of Clinometer compass Calculation of apparent and True dip Determination of Vertical and True Thickness of bed. Study of structural models, Study of Geological maps  Study of Rocks in hand specimens: Granite, Syenite, Diorite, Dolerite, Gabbro, Dunite, Rhyolite, Basalt, Quartzite, Marble, Schist and Charnockite, pegmatite Study of rock types in hand specimens: Pegmatite, Sandstone, Limestone, Conglomerate, Shale, Phyllite, Slate and Gneiss. Petrography of important rocks in thin sections.	30 +3 0
<b>Suggested Readings:</b> 1. F.H.T.Rhodes, geological maps, the commonwealth and international library. 2. G.M.Bennison, 1992, an introduction to geological structures and maps, Edward Arnold 3. Richard J.Lisle, 1988, Geological structures, and maps, a practical guide, Amsterdam 4. K.R.McClay, 1991, The mapping of geological structures, geological society of London handbook		

Programme/Class: <b>Diploma</b>		Year: <b>Second</b>	Semester: <b>Third</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>PALAEONTOLOGY</b>	
Course outcomes: After completing the course, student will know the palaeo-life of earth Will know the reconstruction of the earth based on fossils Will be able to determine the age of rock formation- based fossils will be able to locate the resources based on fossils			
Credits:4		Core: <b>Compulsory</b>	
Max.Marks: 25+75		Min.Passing Marks:45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0			
Unit	Topics		No. of Lectures
I	Introduction to palaeontology; processes of fossilisation; Preliminary idea of the origin of life; Basic idea of trace fossils and their uses		7
II	Morphology and geological history of Gastropoda, Cephalopoda		8
III	Morphology and geological history of Bivalvia, Brachiopoda		8
IV	Morphology and geological history of Echinoidea.		8
V	Morphology and geological history of Trilobita		8
IV	Introduction to Palaeobotany; Important Lower and Upper Gondwanan plant fossils		7
VII	Brief idea of concept of species; Classification of organisms; Principles of marine geology, palaeoecology.		7
VIII	Principles of sequence stratigraphy; Micropalaeontology and its use		7
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. Cowen, R. (2000) History of Life, Blackwell Science.</li> <li>2. E.N.K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science</li> <li>3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press</li> <li>4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing</li> <li>5. Patrick Wyse Jackson, (2019) Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.</li> <li>6. Raymond Enay (2012) Palaeontology of Invertebrates, Springer-Verlag.</li> <li>7. Peter Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.</li> <li>8. Morley Davies (2008) An Introduction to Palaeontology, Read Books.</li> <li>9. Sreepat Jain (2017) Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India</li> <li>10. Roland Goldring, (2014) Field Palaeontology, Routledge</li> <li>11. Johansson, C.Z., Underwood, M. Richter, (2019) Evolution and development of Fishes, Cambridge University Press.</li> <li>12. Pratul Kumar Saraswati, M.S. Srinivasan, (2016) Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.</li> <li>13. Michael Benton, David A. T. Harper, (2009) Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell.</li> <li>14. Colbert, E.H. and Minkoff, Eli C. (2001) Evolution of vertebrates, Wiley Liss</li> </ol>			

Programme/Class: <b>Diploma</b>		Year: <b>Second</b>	Semester: <b>Third</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>STRATIGRAPHY</b>	
Course outcomes: After completing the course, student Will learn the presence of different types Will understand fundamentals of stratigraphy and its branches. Will be able to identify potential zone of earth resource			
Credits: 4		Core: <b>Compulsory</b>	
Max. Marks: 25+75		Min. Passing Marks: 45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topics		Lectures
<b>I</b>	Principles of Stratigraphy; History and Development of Stratigraphy; Stratigraphic Nomenclature,		8
<b>II</b>	Physical and structural subdivisions of the Indian subcontinent and their characters; Brief idea about Archaeans successions of Peninsular India with special reference to the Dharwar Supergroup		7
<b>III</b>	Unmetamorphosed Proterozoic successions of India with special reference to Cuddapah and Vindhyan Supergroups		8
<b>IV</b>	Gondwana Supergroup; Classification, Flora and Fauna and economic importance		7
<b>V</b>	Mesozoic successions of India		8
<b>VI</b>	Stratigraphy of the Deccan Traps and Intertrappean beds		7
<b>VII</b>	Cenozoic stratigraphy: Cenozoic formations of India; Rise of the Himalayas and development of Siwalik Group		7
<b>VIII</b>	Stratigraphy of Bundelkhand Craton		8
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. Doyle, P. and Bennett, M.R., 1996. Unlocking the Stratigraphic Record, John Wiley.</li> <li>2. Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley &amp; Sons.</li> <li>3. Krishnan, M.S., 1982. Geology of India and Burma, C.B.S. Publishers, Delhi</li> <li>4. Naqvi, S.M. 2005. Geology and Evolution of the Indian Plate: From Hadean to Holocene 4 Gato 4 Ka. Capital Pub., New Delhi.</li> <li>5. Pascoe, E.H., 1968. A Manual of the Geology of India &amp; Burma (Vols. IN), Govt. of India Press, Delhi.</li> <li>6. Pomeroy, C., 1982. The Cenozoic Era- Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.</li> <li>7. Schoch, R.M., 1989. Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.</li> <li>8. R. Vaidyanathan &amp; M. Ramakrishnan, 2008. Geology of India, Geological Society of India.</li> <li>9. Geological and Tectonic Aspects of Bundelkhand By S C Bhatt</li> </ol>			

**Practical –III:**

Programme/Class: <b>Diploma</b>		Year: <b>Second</b>	Semester: <b>Third</b>
Subject: <b>Geology</b>			
CourseCode:		CourseTitle:Practical: <b>PALAEONTOLOGY + STRATIGRAPHY</b>	
Credits:2+2		Core: <b>Compulsory</b>	
Max.Marks: 25+75 for each		Min.PassingMarks:40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:0-0-2			
Unit	Topics		No. ofLectures
	Identification of Fossils. Identification of Stratigraphic rocks. Petrography of important rocks.		30+30
<b>SuggestedReadings:</b>			
<ol style="list-style-type: none"> <li>1. Cowen,R.(2000)HistoryofLife,Blackwell Science.</li> <li>2. E.N.K.Clarkson(2013)InvertebratepalaeontologyandEvolution,Blackwell Science</li> <li>3. RhonaM.Black,(1989)TheElementsofPalaeontology,CambridgeUniversityPress</li> <li>4. MichaelBenton,(2005)VertebratePalaeontology,BlackwellPublishing</li> </ol>			

Programme/Class: <b>Diploma</b>		Year: <b>Second</b>	Semester: <b>Forth</b>
Subject: <b>Geology</b>			
Course Code:		CourseTitle: <b>Economic Geology</b>	
Courseoutcomes: Aftercompletingthecourse,student Willidentifythecommonoreminerals. will understand the genetic controls exerted by physical and chemical processes on ore formation invariousgeologic settings, will understand economic and policy issuesrelatedto minerals and theirnationalimportance			
Credits:4		Core: <b>Compulsory</b>	
Max.Marks: 25+75		Min.PassingMarks:45	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0			
Unit	Topics		No. ofLectures
<b>I</b>	Ores and gangues Ores, gangue minerals, tenor, grade and lodes. Definition of ore, Structure and Form of ore deposits.		8
<b>II</b>	Processes of formation of ores: magmatic, hydrothermal, metasomatic, oxidation and supergene enrichment.		7
<b>III</b>	Classification of mineral deposits;Occurrence, origin and distribution of the metallic deposits of India: Copper and Iron.		6
<b>IV</b>	Occurrence, origin and distribution of the metallic deposits of India: Manganese, Gold and Silver.		8



V	Occurrence, origin and distribution of the metallic deposits of India: Aluminium, Chromium, Lead and Zinc.	8
VI	Distribution and mode of occurrence of industrial minerals in India: Mica, Asbestos, Talc, Soapstones, Barytes.	8
VII	Distribution and mode of occurrence of non metallic minerals in India: Building Material, Dimension Stones, Cement, Clay, Granite and marble.	8
VIII	Distribution and mode of occurrence of non metallic minerals in India: Glass Manufacturing Materials, Ceramic minerals and Fertilizer minerals.	7

**Suggested Readings:**

1. Ridley, John. (2013). Ore deposit geology. Cambridge University Press.
2. Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits, John Wiley.
3. Mookherjee, A., 2000. Ore Genesis – A Holistic Approach. Allied Publisher.
4. Craig, J.R., and D.J. Vaughn. "Ore microscopy and ore mineralogy." (1994).
5. Pracejus, Bernhard. 2015. The ore minerals under the microscope: an optical guide. Vol. 3. Elsevier.
6. Bateman, Alan Mara, and Mead L. Jensen. 1950. Economic mineral deposits. Vol. 259. New York: Wiley.

Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Forth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Hydrogeology</b>	
Course outcomes: After completing the course, student Will learn the Hydrological cycle, vertical distribution of subsurface water Will learn about types of aquifers, flow of Ground water and properties of ground water.		
Credits: 4	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: 45	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
I	Introduction and basic concepts scope of hydrogeology and its societal relevance. Hydrologic cycle: precipitation, evapotranspiration, run-off, infiltration.	8
II	Rock properties affecting groundwater, Vertical distribution of subsurface water.	7
III	Geological formations as aquifers, type of aquifers and springs and artesian well.	6
IV	Groundwater flow, Darcy's law and its validity, Porosity and Permeability. Groundwater flow rates and flow direction, Laminar and turbulent groundwater flow.	8
V	Well hydraulics and Groundwater exploration, Basic Concepts (drawdown; specific capacity etc).	8
VI	Groundwater chemistry Physical and chemical properties of water and water quality	8
VII	Groundwater management Surface and subsurface water interaction Groundwater level fluctuations	8

<b>VIII</b>	Basic concepts of water balance studies, issues related to groundwater resources development and management, Rainwater harvesting and artificial recharge of groundwater	7
<b>Suggested Readings:</b>		
<ul style="list-style-type: none"> <li>• Hornberger, G. M. (1998), <i>Elements of physical hydrology</i>, viii, 302 p. pp., Johns Hopkins University Press, Baltimore</li> <li>• Fetter, C. W. (2001), <i>Applied hydrogeology</i>, 4th ed., xvii, 598 p. pp., Prentice Hall, Upper Saddle River, N.J.</li> <li>• Freeze, R. A., Cherry, J.A. (1979) <i>Groundwater</i>. Prentice-Hall, Englewood Cliffs, N.J., 604 p.</li> <li>• Domenico, P.A., and Schwartz, F.W. (1990) <i>Physical and chemical hydrogeology</i>. Wiley, New York, 824p.</li>   <li>• Cook, P. G., and A. L. Herczeg (2000), <i>Environmental tracers in subsurface hydrology</i>, xiv, 529 pp., Kluwer Academic Publishers, Boston.</li> <li>• Clark, I. D., and P. Fritz (1997), <i>Environmental isotopes in hydrogeology</i>, 328 pp., CRC Press/Lewis Publishers, Boca Raton, FL.</li> <li>• Michener, R. H., and K. Lajtha (2007), <i>Stable isotopes in ecology and environmental science</i>, 2nd ed., xxvi, 566 p. pp., Blackwell Pub., Malden, MA.</li> <li>• Käss, W., (1998), <i>Tracing Technique in Geohydrology</i>::Balkema, Rotterdam, The Netherlands, 581 p.</li> <li>• Mazar, I. E. (1997), <i>Chemical and isotopic groundwater hydrology : the applied approach</i>, 2nd , rev. and expand ed., xii, 413 pp., M. Dekker, New York.</li> <li>• Aggarwal, P. K., et al. (2005), <i>Isotopes in the water cycle : past, present and future of a developing science</i>, xv, 381 p. pp., Springer, Dordrecht, The Netherlands.</li> <li>• <u>SAHRA Isotopes &amp; Hydrology</u></li> </ul>		

Practical IV

Programme/Class: <b>Diploma</b>		Year: <b>Second</b>	Semester: <b>Fourth</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: Practical: <b>Economic Geology + Hydrogeology</b>	
Credits:2+2		Core: <b>Compulsory</b>	
Max. Marks: (25+75) for each		Min. Passing Marks: 40	
<b>Unit</b>	<b>Topics</b>		<b>No. of Lectures</b>
	Study of hydrological maps. Drainage analysis, Identification of economic minerals, megascopic and microscopic identification of ore minerals, Measurement of vertical and true thickness of coal seams.		30+30
<b>Suggested Readings:</b>			
<ol style="list-style-type: none"> <li>1. Todd, D.K., 1980: Groundwater Hydrology, John. Wiley.</li> <li>2. Davies, S.N. &amp; De Wiect, R.J.M., 1966: Hydrology, John. Wiley.</li> <li>3. Fetter, C.W., 1990: Applied Hydrogeology, Merrill Publishing.</li> <li>4. Raghunath, N. M., 1982: Groundwater, Wiley Eastern.</li> <li>5. Karanth, K.R., 1987: Groundwater Assessment Development and Management Tata McGraw Hill.</li> <li>6. Alley, W.M., 1993: Regional Groundwater Quality, VNR New York.</li> <li>7. Subramaniam, V., 2000: Water, Kingston Publ. London.</li> </ol>			

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Environmental Geology</b>	
<b>Course outcomes:</b> After completing the course, student Will understand abiotic and biotic components and Physical components of environment. Will understand the causes, effects and relief and remedial measures of Natural Hazards Will understand the causes, effects of water and air pollutants. Will understand the effects of green house gases and Ozone depletion		
Credits:4		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks:40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
<b>I</b>	Basic concept of environmental Geology: Lithosphere, Biosphere, Atmosphere and Hydrosphere.	8
<b>II</b>	Landslides:Types, causes effects and Control.	7
<b>III</b>	Earthquake as hazards; origin, mechanism, magnitude, effects, prediction and control.	6
<b>IV</b>	Important volcanic eruptions, mapping, monitoring and mitigation of volcanoes. Floods as hazards: Types, magnitude, effects and Control.	8
<b>V</b>	Coastal hazard: cyclones, anticyclones, Tides, Tsunamis, Glacial and peri glacial hazards.	8
<b>VI</b>	Water pollution: causes, types of pollutant, effects and treatment of polluted water.	8
<b>VII</b>	Air pollution: causes, types of pollutant, effects and remedial measures.	7
<b>VIII</b>	Green house gases, Ozone depletion, Global warming, Environmental Laws.	8
<b>Suggested Readings:</b> 1. Environmental Geology” by Keller E A. 2. Environmental Geology By K S Valdiya 3. Environmental Geography by Somender Singh 4. “ Natural Hazards” by Bryant E. .. 5. Natural Hazard and Drought in Central India by S. Bhatt, Shree Publishers and Distributors, New Delhi 6. Climatology by D S Lal 7. Geomorphology and Remote Sensing in Environmental Management” by Singh S		

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Mineral Exploration and MiningEngineering</b>	
<b>Course outcomes:</b> After completing the course, student Will understand the mining plans, techniques of opencast and underground Mining Will understand Geophysical exploration and their application in exploration.		

Credits:4		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks:40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
Unit	Topics	No. of Lectures
I	Introduction and common terminology in mining, Elementary concept and important factors for mining,	7
II	Different type of open cast and underground mining methods. Mining planning, exploration and exploratory mining of surface.	8
III	Survey and mining plan methods for open cast mining Open cast Mining: Open pit, Dredging, hydraulic mining, strip mining and mountain top removal.	8
IV	Underground mining: involving drilling, shaft sinking, drifting, cross cutting, winzing, stopping, room and pillaring, top slicing, sub-level caving and block caving.	8
V	Resistivity survey methods for Underground water, Application of electrical methods in ground water prospecting.	8
VI	Exploration Methods, Type of survey, Geophysical Exploration methods.: Principle of gravimeters,	6
VII	Magnetic properties of rocks. Working principle of magnetometers, application in exploration.	6
VIII	Resistivity method: basic principles, various types of electrode configurations.	8
<b>Suggested Readings:</b> Arogyaswamy, R.N.P. (1973): Courses in Mining Geology, Oxford and IBH Publ. Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press. Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual., North Oxford Academic. Davies, S. N. and De Wiest, R. J. N. (1966): Hydrogeology, John Wiley and Sons. Dobrin, M. B., and Savit, C. H., (1988): Introduction to Geophysical Prospecting, McGraw-Hill Book		

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Geochemistry</b>	
Course outcomes: After completing the course, student Will understand the occurrence of elements on earth and cosmos Will understand about Meteorites and their classification.		
Credits:4		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks:45
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
Unit	Topics	No. of Lectures
I	Abundance of elements in the cosmos and earth. Composition of earth with special reference to the upper mantle and the crust.	7

<b>II</b>	Goldschmidt's geochemical classification and differentiation of earth. Geochemical cycle	8
<b>III</b>	Properties of transition and rare earth elements (REE)	8
<b>IV</b>	Basic ideas about Meteorites and classification.	6
<b>V</b>	Geochemical characteristics of Magma Principles of ionic substitution in minerals.	8
<b>VI</b>	Importance of isotopes, Isomorphism, Polymorphism	8
<b>VII</b>	Weathering and soil formation, elemental mobility in surface environment,	7
<b>VIII</b>	Radioactive decay schemes of U-Pb, Rb-Sr, K-Ar, and growth of daughter isotopes	8
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Don L. Anderson 2012 Theory of the Earth Blackwell Scientific Publications</li> <li>2. Alexander R Mc Birney, 2006 Igneous Petrology, III edition: Alexander R Mc Birney</li> <li>3. White, W. M. Isotope Geochemistry. Wiley Blackwell</li> <li>4. Faure, G. and Mensing, T. M. 2009 Isotope principles and Applications.</li> </ol>		

**Practical V:**

Course Code:	Course Title: Practical: <b>Environmental Geology+ Mineral Exploration and Mining + Geochemistry</b>	
Credits:4	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
	Plotting of Seismic Zones, Landslides prone areas and Flood prone areas in Indian maps Identifications of stream orders in Indian rivers. Resistivity survey.	30+30
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Cowen, R. (2000) History of Life, Blackwell Science.</li> <li>2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science</li> <li>3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press</li> <li>4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing</li> </ol>		

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		

Course Code:	Course Title: <b>Remote Sensing &amp; GIS Applications</b>	
<p>Course outcomes:          After completing the course, student          Will understand the principles of aerial photography and photogrammetry.          Will understand the Interpretation of rocks, Drainage pattern, landforms, Geological structures, through aerial photograph and Satellite imageries.          Will understand the characteristics of Landsat, Seasat, Meteosat, SPOT, IRS series, infrared, thermal infrared and Radar images.</p>		
	Credits:4	Core: <b>Compulsory</b>
	Max.Marks: 25+75	Min.PassingMarks:40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
Unit	Topics	No. of Lectures
I	Concepts and principles of aerial photography and photogrammetry.	7
II	Types of films, scale, mosaics, stereoscopy, vertical exaggeration and depth perception.	8
III	Elements of aerial photo-interpretation; Interpretation of types of rocks, Drainage pattern, landforms, Geological structures, Ground water survey, and Mineral exploration through aerial photograph and imageries.	8
IV	An introduction to Remote Sensing: electromagnetic spectrum, radiation laws, remote sensing observation platforms and sensors.	6
V	Satellites programmes and their characteristics: Landsat, Seasat, Meteosat, SPOT, and IRS series etc.	8
VI	False colour composites, characteristics of infrared, thermal infrared and Radar images.	8
VII	An introduction to Geographical Information Systems (GIS),	7
VIII	Global Positioning System (GPS)- principles, components and their applications.	8
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Miller, V.C., 1961: Photogeology. McGraw Hill.</li> <li>2. Sabbins, F.F., 1985: Remote Sensing – Principles and Applications:</li> <li>3. Freeman. Ray. R.G., 1969: Aerial Photographs in Geologic Interpretations. USGS Prof. Paper 373.</li> <li>4. Drury, S.A., 1987: Image Interpretation in Geology. Allen and Unwin.</li> <li>5. Moffitt, F.H. and Mikhail, E.M., 1980: Photogrammetry,</li> <li>6. Harper and Row. Lillesand, T.M. and Kieffer, R.W., 1987: Remote Sensing and Image Interpretation. John Wiley.</li> <li>7. Paine, D.P., 1981: Aerial photography and Image Interpretation for Resource Management. John Wiley.</li> <li>8. Pandey. S.N. 1987: Principles and Applications of Photogeology Wiley Eastern. New Delhi.</li> </ol>		

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Engineering Geology</b>	

Course outcomes: After completing the course, student Will understand the engineering properties of rocks. Will understand the geological and geotechnical considerations of dams, tunnels and bridges. Will understand the causes of landslides and their effects on roads and high ways.		
Credits:4		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks:40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
Unit	Topics	No. of Lectures
I	Engineering geology and its importance in contact to planning, design and construction of projects.	7
II	Various engineering properties of rock i.e., specific gravity, porosity, absorption value, compression strength, tensile strength, shear strength, modulus of elasticity and modulus of compression etc.	8
III	Physical characters of building stones, Dimension and Decorative stones. Metal and concrete aggregates.	6
IV	Dams: Terminology, Classification of Dams reservoirs, geological and geotechnical consideration for dam site, purpose of dams.	8
V	Tunnels: Terminology, classification of ground for tunneling purposes, various types of support. Tunnel in different type of	8
VI	Role of geological studies in selection of tunnel sites, highways and bridges	8
VII	Earthquakes and seismicity, seismic zones of India.	7
VIII	Classification of landslides, Natural and anthropogenic factors responsible for landslides, Corrective measures construction materials and its uses.	8
<b>Suggested Readings:</b> 1. Krynine, D.H And Judd, W.R., 1998: Principles of Engineering Geology, CBS Edition. 2. Sharma, P.V., 1997: Environmental and Engineering Geophysics Cambridge Univ. Pres. 3. Satynarayan Swamy: Engineering Geology		

Programme/Class: <b>Degree</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		
Course Code:	Course Title: <b>Fuel Geology</b>	
Course outcomes: After completing the course, student Will understand the origin, grade, characteristics and distribution of coal. Will understand the origin, characters of oil and distribution petroleum and gas. Will understand the source of Atomic minerals and occurrence of Nuclear power station in India		
Credits:4		Core: <b>Compulsory</b>
Max.Marks: 25+75		Min.PassingMarks:40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0		
Unit	Topics	No. of Lectures
I	Definition and origin of Coal. Rank, grade and type of Coal.	7

II	Indian and international classifications. Chemical characterization: proximate and ultimate analysis.	8
III	Geological and geographical distribution of coal deposits in India. Detailed geology for some important coalfields in of India.	6
IV	Coal production and problems of coal industry in India.	8
V	Petroleum: Its composition and different fractions. Origin, nature and migration (primary and secondary) of oil and gas.	8
VI	Oilfield fluid – water, oil and gas occurrence. Prospecting for oil and gas, drilling and logging procedures.	8
VII	Important Oil basins of India. Position of oil and natural gas in India, future prospects and the economic scenario.	7
VIII	Atomic Fuel: Mode of occurrence and association of atomic minerals in nature. Atomic minerals as source of energy and their deposits. Nuclear power stations of India.	8

**Suggested Readings:**

Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., And Robert, P., 1998: Organic Petrology, GebruderBorntraeger,Struttgart.  
Chandra, D., Singh, R.M., And Singh, M.P., 2000: Textbook Of Coal (Indian Context). Tara Book Agency, Varanasi.  
Singh, M.P. (Ed), 1998: Coal And Organic Petrology, Hindustan Publ, Corp., New Delhi.  
Stach, E., Mackowky, M.T.H., Taylor G.H., Chandra, D., Teichmuller., And Teichmuller, R., 1982: Stach's Text Book Of Coal Petrology, GebruderBorntraeger, Stuttgart.  
Holson, G.D. And Tiratsoo, D.H. 1985: Petroleum Formation And Occurrence, Springer-Verlag.  
Selley, R.C., 1998: Elements Of Petroleum Geology, Academic Press.  
Durance, E.M., 1986: Radioactivity In Geology, Principles And Application,  
Ellis Hoorwool. Dahlkamp, F.J., 1993: Uranium Ore Deposits, Springer Verlag. Boyle, R.W., 1982: Geochemical Prospecting For Thorium And Uranium Deposits, Elsevier

**Practical VI**

Course Code:	Course Title: Practical: <b>Remote Sensing and GIS Applications + Engineering Geology + Fuel Geology</b>	
Credits:4		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: 40
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:0-0-2		
Unit	Topics	No. of Lectures
	<p>Study of Nature aerial photographs: resolution, mosaics, symbols, gully pattern and drainage analysis, image parallax. Determination of scale, height, dip, slope, vertical exaggeration and image distortion. Geological and geomorphologic mapping and in (georesources) vegetation, water and mineral resource evaluation. Exercises on digital image processing. Study of environmental hazard maps morphometric, analysis</p> <p>Megascopic characterization of banded coals. Proximate analysis of coal. Completion of outcrops in the given maps and calculation of coal reserves. Study of geological maps and sections of important oilfields of India. Megascopic study of some uranium and thorium bearing minerals and rocks</p> <p>Study of maps and models of important engineering structures as dam sites, tunnels, Highways.</p>	30
<b>Suggested Readings:</b>		
Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., And Robert, P., 1998: Organic Petrology, GebruderBorntraeger,Struttgart. Chandra, D., Singh, R.M., And Singh, M.P., 2000: Textbook Of Coal (Indian Context). Tara Book Agency, Varanasi. Singh, M.P. (Ed), 1998: Coal And Organic Petrology, Hindustan Publ, Corp., New Delhi. Stach, E., Mackowky, M.T.H., Taylor G.H., Chandra, D., Teichmuller., And Teichmuller, R., 1982: Stach's		



Text Book Of Coal Petrology, GebruderBorntraeger, Stuttgart.  
 Holson, G.D. And Tiratsoo, D.H. 1985: Petroleum Formation And Occurrence, Springer-Verlag.  
 Selley, R.C., 1998: Elements Of Petroleum Geology, Academic Press.  
 Durance, E.M., 1986: Radioactivity In Geology, Principles And Application,  
 Ellis Hoorwool. Dahlkamp, F.J., 1993: Uranium Ore Deposits, Springer Verlag. Boyle, R.W., 1982:  
 Geochemical Prospecting For Thorium And Uranium Deposits, Elsevier  
 1.

### Minor I(GE): Disaster Management

Programme/Class: <b>Degree</b>		Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>Disaster Management</b>	
Course outcomes: After completing the course, student Will understand the causes, effects and control of all natural and man-made disasters. Will understand the methodology applied for Disaster preparedness, Risk analysis Will understand the techniques for Relief operation and rehabilitation			
Credits:4		Core: Elective	
Max.Marks: 25+75		Min.PassingMarks:40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0			
<b>I</b>	Introduction on Disaster Different Types of Disaster: A) Natural Disaster: and Man-Made Disaster (Man-made Disaster: such as Fire, Nuclear Disaster, Biological Disasters),		<b>8</b>
<b>II</b>	Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides, Drought		10
<b>III</b>	Water pollution, air pollution, Industrial pollution, Noise and Thermal pollution; Effects and control		7
<b>IV</b>	Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge),		7
<b>V</b>	War & Terrorism etc. Causes, effects and practical examples for all disasters. 12 II Risk and Vulnerability Analysis		7
<b>VI</b>	Risk: Its concept and analysis 2. Risk Reduction 3. Vulnerability: Its concept and analysis 4. Strategic Development for Vulnerability Reduction 12 III Disaster Preparedness and Response Preparedness1.		8
<b>VII</b>	Disaster Preparedness: Concept and Nature 2. Disaster Preparedness Plan 3. Prediction, Early Warnings and Safety Measures of Disaster		7
<b>VIII</b>	4. Role of Information, Education, Communication, and Training, 14		6
<b>Suggested Readings:</b>			

**Minor II(SEC/AEC): Gems and Dimension Stones**

Programme/Class: <b>Degree</b>		Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>			
Course Code:		Course Title: <b>Gems and Dimension Stones</b>	
Course outcomes: After completing the course, student Will understand the I. Will understand the. Will understand the			
Credits:3		Core: Elective	
Max.Marks: 25+75		Min.PassingMarks:40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0			
<b>I</b>	Introduction: Types of Gems and Dimension stones, Their geological and commercial names		<b>6</b>
<b>II</b>	Basic qualities; Chemical composition; Weights and measures of gems.		6
<b>III</b>	Nature of crystals; Systems of crystallography; Crystalline and non-crystalline materials; Forms; Habit; Twinning of Gems.		6
<b>IV</b>	GEM IDENTIFICATION: Instruments Used; Jeweler's Lens; Microscope; Spectroscope; Dichroscope; Chelsea color filter; Ultraviolet light and X-rays; Polariscopes; Refractometer.		7
	Different methods of manufacture; Characteristics; Identification.		6
	DESCRIPTION OF GEM STONES: The varieties and colours, species, chemical composition and crystal systems, physical properties, and provenance of the following gemstones: Amber; Andalusite; Apatite; Axinite; Aragonite; Beryl Emerald, Aquamarine, Morganite, Goshenite; Calcite;		7
	The varieties and colours, species, chemical composition and crystal systems, physical properties, and provenance of the following gemstones: Chrysoberyl: Alexandrite, Cat's eye; Coral; Corundum: Ruby, Sapphire, Star Ruby/Sapphire; Cassiterite; Diamond; Enstatite; Epidote; Feldspar Group: Moonstone, Albite, Orthoclase, Plagioclase, Labradorite, Sunstone, Fluorspar; Garnet Group: Almandine; Pyrope, Grossular, Andradite; Spessartite, Uvarovite; Haematite; Howelite; Idocrase; Iolite; Ivory; Jadeite; Kornerupine; Kyanite; Malachite; Nephrite; Obsidian; Odontite;		8
	Opal; Types properties and uses: Fire Opal, White Opal, Black Opal, Water Opal; Pearl : Australian, , Black, Blue, Pyrites; Quartz : Rock crystal, Amethyst, Smoky Quartz; Rose Quartz; Aventurine, Quartz Cat's eye, Tiger's eye, Rutilated Quartz; Chalcedony Group : Chalcedony; Carnelian, Chrysoprase, Moss Agate, Jasper, Bloodstone, Rhodonite; Sodalite;		8

	Smithsonite; Sphene; Topaz; Tourmaline ;, Rubellite, Zircon; Zoisite.	
	Dimesion and Decorative stones stones: properties uses and marketing	6
<b>Suggested Readings:</b>		

