तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
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बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ BU/Geol/2022/325

दिनाँक 30.6.2022

The Minutes of Meeting of BOS

In reference to the BOS of department of Geology (U.G.(B.Sc.Hons) & P.G.), Institute of Earth Sciences held on 30.6.2022 regarding the revision of syllabus in tune with ~~CBCS~~/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

30/6
HOD/Coordinator
Head,
Department of Geology
Bundelkhand University JHANSI

Institute of Earth Sciences
Department of Geology
Bundelkhand University Jhansi

Ordinance and Syllabus for
M.Sc. Geology Program
(National Education Policy 2020)

Academic Session – 2022-23 and onwards

ORDINANCE FOR POSTGRADUATE PROGRAMMES

(CBCS SYSTEM & NEP 2020)

ARTS, SCIENCE & COMMERCE FACULTIES

(2022 onwards)

1. INTRODUCTION

1.1 Preamble

This ordinance governs all the rules and regulations as per the NEP 2020 for the traditional post graduate programs (M.A., M.Sc., M.Com, Management courses. etc) which are not covered by any regulatory bodies (AICTE, BAR Council, PCI, NCTE etc) running in the University campus or its affiliated colleges in Bundelkhand University, Jhansi. This ordinance supersedes all the previous relevant ordinances, rules and regulations.

1.2 Duration

Bundelkhand University has adopted the CBCS system in various Postgraduate courses as per guidelines of Higher Education Department, Uttar Pradesh Government vide letter No 401/seventy-3-2022 dated 09-02-2022 to accelerate the teaching-learning process and enable vertical and horizontal mobility in learning from the academic session 2022- 23 onwards.

The duration of PG courses shall of two years comprise of four semesters. In case a student(s) exits from this programme after completion of the first year (2 semesters), he/she may take exit from the programme and shall be awarded the Degree of Bachelor in Research. After the successful completion of two years (4 semesters) a student shall be awarded the Master's degree in the concerned subject. The maximum duration to complete the course shall be four years.

1.3 Eligibility for Admission

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

  -passed the three years Bachelor's degree course Examination of the University of Uttar Pradesh or any other Indian University incorporated by any law in force at the time of admission.
  or
  -passed any other equivalent examination recognized by the University as equivalent thereto.
  -passed any other equivalent examination recognized by a Foreign University as equivalent thereto

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

1.4 Choice of Subject and Course Structure

i. University/ College shall admit students as per the eligibility criteria and availability of seats decided by the university.

ii. A student shall take admission to post graduation first year of fourth year of Higher Education program of NEP 2020 after successful completion of Graduate course from NEP 2020 or old course of Science/ Arts/ Commerce/ Management, etc. He/she shall have to choose respective faculty courses as per guidelines of NEP 2020 depending on the number of seats available in concerned subject and eligibility criteria. In case a candidate is willing to change the faculty, the following conditions are required-

The candidate who has passed Bachelor degree in Science/ Commerce of NEP 2020 or old courses may take admission in some subjects of Arts faculty (excluding practical subjects like geography, psychology etc). Similarly, the Student from Commerce of NEP or old course of commerce may also be eligible to take admission in Arts subjects. Arts, Management and Commerce candidates cannot be admitted in Science subjects.

iii. Student(s) shall select subjects for Post graduation course from the major subjects that he / she had opted in the graduation course and shall continue with the same subjects in all the four semesters of the PG programme.

iv. The course structure shall be as follows:

There shall be four compulsory theory papers in the first semester. In the third and fourth semester there shall be minimum two compulsory papers and one/ two elective papers. The elective papers shall be specialization papers.

Student(s) shall have to select one open elective paper as **Minor subject** from any other faculty (except own faculty) or an interdisciplinary subject in the first semester of the first year.

v. Student(s) shall take a Research Project /Survey/ Industrial /Field training program etc. in both the years (Semester I,II,III and IV). No pre-requisite shall be required for this.

vi. List of Minor Elective Courses: The candidate shall select any one subject from the following as minor subject in first year of post graduate course.

Table-1

S No	Science	Arts	Commerce	Interdisciplinary
1.	Mathematical Biology	Tribal Culture and Heritage	Customer Relationship Management	Ancient Medical Sciences
2.	Natural Resources and Conservation	Social Sector and Gender Economics	House Keeping and Hospitality	Traditional Medical Therapy
3.	Pollution: Causes and Mitigation	Socio-Economic and Social Security	Share Market and Banking	Vedic Mathematics
4.	Computational Research	Archeological Sites and Monuments	Marketing and Accounting	Medicinal and Aromatic Plants Cultivation, extraction and nutraceutical Values
5.	Data Science	Constitution of India	Insurance Policy and Finance	Disaster Management
6.	Computer Hardware Handling	Communication and Personality Development	Advertising Management	Medicinal Biochemistry
7.	Computer Software Handling	Film, TV, Documentary Patkatha Lekhan	Digital Marketing	Soil and Water Testing
8.	Cyber Crime	Urban Growth & Development Economics	Human Resource Management	Climate Change and Environmental Degradation
9.	Bee Keeping, Aquaculture and Fish Farming	Urban Economics and Planning	Organizational Behavior	Spiritual Wellness

2. **SEMESTER AND CREDIT DISTRIBUTION**

An academic year for post graduate program is divided into four semesters. The Odd semesters may be scheduled from July to December and Even semester from January to June.

Fourth Year

	VII Sem	Credits	VIII Sem	Credits
Major	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**
Minor	Minor Elective-1 paper of 04 credits	04 Credits **Total Credits=04**		
Research Project/ Industrial training/ Survey/ Field Training	One of each 04 Credits	04 Credits **Total Credits=04**	One of each 04 Credits	04 Credits **Total Credits=04**
Total Credits		28		24
Total in Both Semester				**52 Credit**

Fifth Year

Semester	**IX**	**Credits**	**X**	**Credits**
Major	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**
Research Project / Industrial training / Survey	One of each 04 Credits	04 Credits **Total Credits=04**	One of each 04 Credits	04 Credits **Total Credits=04**

Total Credits		24		24
Total in Both Semester	**48 Credit**			

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. EXAMINATION

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 upto the maximum duration of the course.
2. It is mendatory for a student to get enrolled/ registered for the first semester examination. 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 the examination of that semester. Such student(s) shall appear in the (next) subsequent examination of that semester as back paper.

5. EVALUATION

The performance of a student in each course shall be 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. 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/papers may be changed /modified by Dean's committee whenever required.

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 – 05marks

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 - 10marks
- Attendance/activities – 05marks

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 40%, i.e. 40 out of 100 marks for theory and practical courses. The minimum passing standard for Aggregate in a semester end Examination shall be 40%.
2. Continuous Internal Assessment (CIA) shall be ensured by the Principal of the colleges / HODs for the Campus 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 40% marks (i.e. 30/75) in the theory and (10/25) practical paper separately.

7. PROVISION FOR BACK PAPERS AND EX-STUDENTS

A Back Paper (B.P.) candidate shall be promoted to the 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 Bundelkhand University shall be eligible for back paper facility as under

2. 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 subjects/ papers and minor paper otherwise he/she shall be deemed as failed and will be treated as a year back / ex- student.
3. 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.

4. Special back paper examination shall be held only for regular students of the final year of PG course.
5. 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.

8. PROMOTION RULES

8.1 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.

8.2 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:

Passed
Promoted with Back Paper(s)
Failed

8.3 Promotion to Next Semester

All students under category Passed and promoted with back papers shall be promoted to the next Semester (as mentioned in Point 7)
"Failed" students may clear their UNCLEARED courses in subsequent examinations as ex-students.
Students promoted with back papers shall clear their back papers in subsequent examinations as ex-students.

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 four 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:

8.4 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, elective, open elective papers (Minor) and the required credit for each paper shall be formulated by respective Board of Studies (BOS). 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, 1credit= 1Tutorial period of one hour duration, 1credit=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(average)	6
F(Fail)	<4
Ab (Absent)	0

The minimum passing marks shall be 40%of the maximum marks as prescribed in the University Examination and 40%of marks in the aggregate marks in the subject including internal / sessional marks. i.e. Minimum Passing Grade is "B".

A student who obtains Grades "O"or"B" 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 40% / B grade in any theory / practical / internal / sessional / viva-voce / internship / project examination, the awarded grade point shall be ZERO (0).

8.5 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). The Cumulative Grade Point Average (CGPA) will be calculated in end of final semester. The grading system except pharmacy department will be with following letter grades and grade points scale as given below:

Table

Level	**Outstanding**	**Excellent**	**Very Good**	**Good**	**Average**	**Fail**
Letter Grade	O	A+	A	B+	B	F
Grade Points	10	9	8	7	6	0
Score (Marks) Range (%)	≥90 (90-100)	<90, ≥80 (80-89.99)	<80, ≥70 (70-79.99)	<70, ≥60 (60-69.99)	<60, ≥40 (40-59.99)	<40 (0-39.99)
Award	**First Division with Distinction**		**First Division**		**Second Division**	**Fail**

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.
2. The University has the right to scale/moderate the theory exam / practical exam / internal exam / sessional marks of any subject when ever 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.

9 CONVERSION OF GRADES IN TO PERCENTAGE

Conversion formula for the conversion of CGPA into Percentage is
CGPA Earned **x 9.5 = Percentage of marks scored.**

Illustration: CGPA Earned 8.6 x 9.5 = 82.0%

10. 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.

DEPARTMENT OF GEOLOGY, INSITUTE OF EARTH SCIENCES, BUNDELKHAND UNIVERSITY, JHANSI

The Department of Geology was established in 1 November 1999 and is running B.Sc. (Hons), M.Sc. (Geology) and Ph.D. courses. The main objective of the department is to impart knowledge in the field of Structural Geology, Tectonics, Precambrian Geology, Sedimentology, Geomorphology, Remote Sensing and Environmental Geology. The department is recognized as Centre of Excellence of U.P. Government and is sponsored by FIST program of DST, Government of India. Bundelkhand is blessed with great geological diversity and consists of different rocks of Archean to recent times. The department endeavors to train and promote students in various disciplines of geology and is encouraging them to develop skill and abilities to get employment in various organizations**.**

Vision:

Be an internationally acclaimed institute of the university. Recognized for excellence in teaching and has potential to produce academician, researchers and professionals of national and international fame in the field of Earth Sciences. To promote growth of intellectual citizens for exploring placement in the various reputed organizations. The main objective is to strive, achieve, and maintain a worthy and commendable position in the field of geology. To endeavor and accomplish this in our students by imparting, disseminating, participating, and contributing knowledge, skills, and rational values with a local, national, and global perspective, to them.

Mission:

Promote advance and innovative teaching and to improve the quality of research in various disciplines of geological sciences. To create innovative and original research programs to students through multi-faceted education and for recognition of the department at national and international level.

Program outcome (POs):

The Master program in geology running at Department of Geology, Bundelkhand University facilitates the knowledge of various branches of geology to students. The students will also learn about tectonics, mineral resources, landscapes, rocks, fossils, water resources, engineering structures, economic and atomic minerals, fuels, Natural hazards and the dynamics, structure, origin, and evolution of the Earth and Solar System. It develops skill and train students to explore the theoretical and practical knowledge for building their carrier and getting jobs in various organizations related to Earth Science. The students will also learn the courses of geological sciences with other comprehensive/ interdisciplinary courses (physics, chemistry, ecology, biology, Environmental science, archaeology, and climatology,) to build their carrier in interdisciplinary research and academic institutes and universities.

The students obtained master degree in Geology are able to get rewarding career opportunities as geologists, scientists, academician, researchers and consultants in government and nongovernment organizations. Since last twenty years the most of the students passed master degree in geology from Bundelkhand University have got jobs in various organizations. Most of the alumni of the department are serving in Geological Survey of India (GSI), Mineral Exploration Corporation (MECL), Atomic Mineral Division, Oil and Natural Gas Commission (ONGC), National Geophysical Research, Geotechnical Companies, Central ground water board, Mining areas, Coal India Limited, WAPCOS, CIMFR etc.

Programme Specific Outcomes (PSOs):

The subject Geology has significant interdisciplinary and applied approaches and links with other scientific and technical programs such as geophysics, geochemistry, remote sensing, environmental sciences, climatology, meteorology, atmospheric sciences, paleobiology, paleobotany, geoarchaeology and other branches. These interdisciplinary programs will provide brighter future to students to build

their carrier in different organizations and institutes. The broad course objectives and teaching methodology are outlined under the appropriate courses and papers.

Syllabus: Course Structure for M.Sc. Geology Program

Semester I			
Paper Code	Course title	Credit	Remarks
1	General Geology and Remote Sensing	4	Core Course
2	Structural Geology and Tectonics	4	Core Course
3	Mineralogy and Crystallography	4	Core Course
4	Igneous Petrology and Geochemistry	4	Core Course
5	Practical- I (Related to paper 1&2)	2	Related to paper 1&2
	Practical- I (Related to paper 3&4)	2	Related to paper 3&4
6	Minor Paper from Table 1	4	
7	Field Training/Field Tour/Industrial Visit	4	Core Course
	Total credit	28	
Total Credit of Semester I			
Semester II			
8	Sedimentology	4	Core Course
9	Palaeobiology and Stratigraphy	4	Core Course
10	Economic Geology	4	Core Course
11	Metamorphic Petrology	4	Core Course
12	Field Training/Field Tour/Industrial Visit	4	Core Course
13	Practical- II (Related to paper 8&9)	2	Related to paper 8&9
	Practical- II (Related to paper 10&11)	2	Related to paper 10&11
	Total credit ot first Semester	24	
Total Credit of First YEAR		**52**	
Semester III	**Note: Any two from elective courses**		
14	Exploration and Mining Geology	4	Core Course
15	Environmental Geology	4	Core Course
16	(i) Hydrogeology / (ii) Hydrogeological Modeling and Management	4	Elective Course- I
17	(i) Fuel Geology/ (ii) Petroleum Geology	4	Elective Course-II
18	Field Tour/Training	4	
19	Practical III (Related to paper 14-15)	2	(Related to any two of 14-15)
	Practical III (Related to paper 16-17)	2	Related to paper 16&17
	Total Credit of Semester III	24	
Semester IV	**Note: Any two from elective courses**		
20	Engineering Geology	4	Core Course
21	Disaster Management	4	Core Course
22	(i) Medical Geology/ (ii) Earth Energy Resources	4	Elective Course-III
23	(i) Quaternary Geology/ (ii) Advance Geomorphology	4	Elective Course-IV
24	Dissertation/Project Work	4	Master Thesis
25	Practical-IV (Related to 20 & 21)	2	Related to 22 & 21
	Practical-IV (Related to 22-23)	2	Related to 22-23
Total Credit of Semester IV		24	
Total Credit of I, II, III and IV Semester		**100**	

Syllabus
M. Sc. I Year

Programme: **M.Sc**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **General Geology and Remote Sensing**	

Course outcomes (COs): After completing the course, student

Will learn about the solar system and origin, shape & interior of earth

Will understand types of weathering and action of geological agents

Will understand principles of remote sensing and characteristics of satellite imageries, aerial photographs

Will understand application of Remote sensing and GIS in Hazard zone mapping, evaluation of ground water potential and tectonic features and preparation of thematic maps

Credits: 4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:3-0-0

Unit	Topics	No. of Lectures
I	The scope and branches of geology, solar system, origin, shape and dynamics of solid earth, age of earth, geological time scale.	7
II	Geomorphological studies: concepts of geomorphology, geomorphic processes and resulting features caused by the geological agents-wind, river, glacier, ocean and underground water.	8
III	Morphometric analysis and geomorphological mapping based on genesis of landforms. Eathquakes, Earth's interior, Isostasy, Volcanoes.	7
IV	Principles of remote sensing: general idea about electromagnetic spectrum, Radiation laws, black body and real body radiation, atmospheric effects, atmospheric windows.	7
V	Interaction of earth surface features with EMR, remote sensing observation platforms, satellites, sensors. Global and Indian space a missions, Different satellite exploration programs and their characteristics: LANDSAT, METEOSAT, SEASAT, SPOT, IRS	8
VI	Photogrammetry: Principals of Aerial Photography, types of aerial photographs, normal, drift and crab, aerial camera and lenses, stereoscopy, stereoscopic vision and depth perception, geometric characteristics of aerial photographs, elements of photo interpretation.	9
VII	Geological studies: image characters and their relation with ground objects based on tone, texture and pattern; principles of terrain analysis, evaluation of groundwater potential, rock type identification; and interpretation of topographic and tectonic features.	7
VIII	Terrain evolution for strategic purpose: Methods for landslide hazard zonation, phase of activities, preparation of thematic maps, Application of thematic maps. Principles and applications of geographic information system (GIS)	7

Suggested Readings:

Books Recommended:

Miller, V.C., 1961: Photogeology. McGraw Hill.
Sabbins, F.F., 1985: Remote Sensing – Principles and Applications: Freeman.
Ray. R.G., 1969: Aerial Photographs in Geologic Interpretations. USGS Prof. Paper 373.
Drury, S.A., 1987: Image Interpretation in Geology. Allen and Unwin.
Moffitt, F.H. and Mikhail, E.M., 1980: Photogrammetry, Harper and Row.
Lillesand, T.M. and Kieffer, R.W., 1987: Remote Sensing and Image Interpretation. John Wiley.
Paine, D.P., 1981: Aerial photography and Image Interpretation for Resource Management. John Wiley.

Pandey. S.N. 1987: Principles and Applications of Photogeology Wiley Easterm. New Delhi.
General Geology by Thornbory, Savindra singh, A. Holme
The Blue Planet: An Introduction to Earth System Science–B.J. S kinner and S.C. Porter.1995, John Wiley &Sons, Inc.493p.
Introduction to Physical Geology–G.R. Turk.1998, Saunders College Publishers, FortWorth.371p.
Processes that Shape the Earth –D.M. Thompson.2007, Infobase Publishing N Y.116p.
Physical Geology–L.D. Leet, S. J udson and M.E. Kauffman, (1982). Prentice-HalInc. 629p.
Holme's Principles of Physical Geology–P. MvL.D. Duff, Fourth Edition (1993). Stanley Thornes(Publishers)Ltd

Programme/Class: **M.Sc.**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **Structural Geology and Tectonics**	

Course outcomes (COs): After completing the course, student

Will learn about the rheological characters of rock, stress –strain and mechanism and recognition of folds

Will understand the significance of π – and β-diagrams, types & mechanism of faulting, Fractures and joints

Will understand concept of Plate Tectonics, Continental drifting, Sea floor spreading and origin of Himalaya,

Credits:4	Course: **Core Course**
Max.Marks: 30+70	Min.Passing Marks: 40

Total No.of Lectures-Tutorials-Practical(in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Rheological properties of rocks and their controlling factors. Bedding and outcrop, Dip and Strike, Age relationship and unconformity	7
II	Concept of stress and strain, Types of strain ellipses and ellipsoids, their properties and geological significance, Strain markers in naturally deformed rocks, Flinn diagram and Mohr circle application.	8
III	Folds, Terminology and classification, mechanism of folds, distribution of strains in folds. Planar and linear fabrics in deformed rocks, their origin and significance.	8
IV	Concept of petrofabrics and symmetry. Significance and limitations of π – and β-diagrams. Geometrical analysis of simple and complex structures on macroscopic scale.	8
V	Theory of rock failure, fault, terminology and types of faulting causes and dynamics of faulting, strike-slip faults, normal faults, over thrust and window, klippe and nappe. Fractures and joints, their nomenclature and their strain significance.	8
VI	Plate Tectonics: Introduction, Orogeny and epirogeny Anatomy of orogenic belts, Continental and oceanic crust.	8
VII	Continental drift and Sea floor spreading, Plate boundaries, Oceanic trenches, Mid Oceanic ridges	7
VIII	Island arc, Subduction zone, structure and origin of the Himalayan belt	6

Suggested Readings:.
Badgley, P.C., 1965: Structure and Tectonics. Harper and Row.
Hobbs, B.E., Means, W.D. and Williams, P.F., 1976: An Outline of Structural Geology, John Wiley.
Davis, G.R., 1984: Structural Geology of Rocks and Region. John Wiley
Bailey, B., n1992. Mechanics in Structural Geology, Springer.
Davis, G. H. and Reynolds, S.J.,1996. Structural Geology of rocks and regions, J ohn Wiley. AndSons.
Ghosh, S.K.,1993. Structural Geology: Fundamentals, and modern developments, Pergamon Press.
Leyson, P: R.andLisle,R.J.,1996.Stereographicprojectiontechniquesinstructural geology,Cambridge UniversityPress.
Passhier, C. and Trouw, R.A. J, 2005. Microtectonics. Springer, Berlin.
Pollard, D.D. and Fletcher, R.C., 2005.Fundamentalsofstructural geology, Cambridge University Press.
Ramsay, J. G. and Huber, M. I., 1983.Techniques of Modern Structural Geology: vol. I & I. Academic Press.
Ramsay,J.G,1967.Folding and Fracturing of Rocks, McGraw-Hill Book Company,NewYork.
Rowland, S. M., Duebendorier, E. and Schiefelbein, I. M., 2007. Structural analysis and synthesis: a laboratory course in structural geology, Balckwell pub.
Suppe,J.,1985ThePrinciplesofStructural Geology,Prentice-Hall,Inc.,NewJersey,.
Twiss,R.J.andMoores,E.M.,2007.Structural Geology.Freeman.
Vander Pluijm,B.A.and Marshak,S.,2004.Earth structure: an introduction to structuralGeology

Practical – I (part-1):

Programme: **M. Sc.**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **Practical I (General Geology and Remote Sensing +Structural Geology and Tectonics)**	

Course outcomes (COs):
After completing the course, student
Will understand the significance and application of aerial and Satellite images Geological and geomorphological maps.
Will learn about digital image processing, environmental hazard maps and morphometric, analysis.
Will be able to interpret the geological maps and structural data, Plotting of π and β diagrams.

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Practical: Study of Nature aerial photographs: resolution, mosaics, symbols, gully pattern and drainage	10
II	Analysis, image parallax. Determination of scale, height, dip, slope, vertical exaggeration and image distortion.	10
III	Geological and geomorphologic mapping and in (georesources) vegetation, water and mineral resource evaluation.	10
IV	Exercises on digital image processing. Study of environmental hazard maps morphometric, analysis.	10
V	Preparation and interpretation of geological maps and cross sections v. rules, Problems related to structures, Plotting of π and β diagram on equal area	10
VI	Stereographic net. Study of Map Projections. Completion of outcrops, estimation of vertical true anticlines.	10

Suggested Readings:

Programme/Class: **M.Sc.**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **Mineralogy and Crystallography**	

Course outcomes (COs):
After completing the course, student
Will understand structure, Physical characters of minerals and their types
Will understand the symmetry, crystal forms and occurrences of thirty two crystal classes
Will learn optical properties of minerals and preparation of thin sections

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Structure of atoms, elements of crystal bonding, coordination number, ionic size valance bond and molecular orbital theories, classification of minerals, silicate structure.	7
II	Systematic mineralogy (crystal structure, classification, mineral chemistry and their experimental work and P-T stability, mode of occurrence) of silicate group of minerals (Olivine, Garnet, Pyroxene, Amphibole)	8
III	Silicate group of minerals (Mica, Aluminosilicate, Feldspar, Chlorite, Coordierite, Silica) native elements, sulfides, oxides and hydroxides. Gem and semi precious minerals.	8
IV	Properties, symmetry elements and forms present in 32 classes of crystal system.	8
V	Principles of optical technique for identification of mineral in nicol-prism, polarizing petrological microscope and its working, uniaxial and biaxial, Indicatrix and Bisectrix, scheme of pleochroism in microscope.	8
VI	Important optical properties of rock forming minerals. Staining and model count techniques.Techniques in photomicrography determination of R.I, optical accessioning.	7
VII	Practical: Megascopic identification of minerals, microscopic study of rock forming minerals using optical accessories.	7
VIII	Preparation of thin section and polished section making, etching and staining. Instrumentation and analytical techniques. Calculation of mineral formula of silicate minerals.	7

SuggestedReadings:
Klein, C. and Hurlbut, Jr., C.S., 1993: Mineralogy. John Wiley.
Putnis, Andrew, 1992: Introduction to Mineral Sciences. Cambridge University Press.
Spear, F.S. 1993: Mineralogical Phase Equilibria and Pressure – Temperature – Time Paths. Mineralogical Society of America Publ.
Phillips, Wm, R. and Griffen, D.T., 1986: Optical Mineralogy, CBS Edition.
Hutchinson, C.S., 1974: Laboratory Handbook of Petrographic Techniques. John Wiley.
Deer, Howie, Zussaman: An introduction to Rock forming minerals
Phillips Mineralogy
Dana Mineralogy
Cornelis Kleinand Barbara Dutrow, 2007,The manual of Mineral Science,Wiley Publication
Albarede, F,2003. An introduction to geochemistry. Cambridge University Press

Programme/Class: **M.Sc.**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **Igneous Petrology and Geochemistry**	

Course outcomes (COs):
After completing the course, student
Will learn about evolution of magma, texture and classification of igneous rocks.
Will learn petrogenesis of rocks and plotting of variation diagrams trace and REE elements
Will understand the classification, Geo-Chronology, Radiogenic isotopes of meteorites
Will understand characters & nature, abundance of Stable isotopes

Credits:4	Course: Core Course
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical(in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Physics and Chemistry of magma; Magmatism in relation to global tectonics; Evolution of magma and factors effecting to it; Phase equilibrium of different silicate systems.	8
II	Textures and micro structures of igneous rocks; Classification of igneous rocks; Rock suite, Rock series and Rock association.	8
III	Petrogenetic provinces of India; Major igneous complexes of India; Petrogenesis of major igneous rock types such as ultramafic, Komatiites, basaltic, granitic and alkaline rocks.	8
IV	Geochemical data calculation and their application in petrology. Preparation of variation diagrams, major, trace and REE bivarient and trivarient and their interpretation in petrology.	8
V	Origin and abundance of elements in the Solar system and Earth and its constituents. Properties of transition and rare earth elements (REE), Geochemical classification of elements, Geochemical cycle (major & minor).	8
VI	Meteorite and its classification. Geo-Chronology, Radiogenic isotopes, Radioactive decay schemes of U-Pb, Rb-Sr, K-Ar, and growth of daughter isotopes, Radiometric dating of single minerals and whole rocks.	8
VII	Stable isotopes (carbon), nature, abundance, and fractionation. Fluid interactions in geological processes**.**	6
VIII	Principles of ionic substitution in minerals, Isomorphism, Dimorphism, Trimorphism, Polymorphism, Ionic potential.	6

SuggestedReadings:

Philijpotts, A. 1992: Igneous and Metamorphic Petrology. Prentice Hall.
Best, M.G., 1986: Igneous Petrology. CBS Publ.
McBirney, A.R., 1993: Igneous Petrology Jones & Bartlet Publ.
Bose, M.K., 1997: Igneous Petrology World Press.
Mason, B. and Moore, C.B., 1991: Introduction to Geochemistry, Wiley Eastern.
Krauslopf, K.B., 1967: Introduction to Geochemistry, McGraw Hill.
Faure, G., 1986: Principles of Isotope Geology, John Wiley.
Hoefs, J., 1980: Stable Isotope Geochemistry, Springer Verlag.
Marshal, C.P. and Fairbridge, R.W., 1999: Encyclopafedia of Geochemistry, Kluwer Academic**.**

Practical I (part-2)

Programme: **M.Sc**	Year:**First**	Semester: **First**
Subject: **Geology**		
Course Code:	Course Title: **Practical I (Mineralogy and Crystallography + Igneous Petrology and Geochemistry)**	

Course outcomes (COs):
After completing the course, student
Will learn identification of minerals in hand specimen and their microscopic characters
Will understand megascopic and microscopic characters of igneous rocks
Will understand Norms, Preparation of Variation diagrams.
Will learn Calculation of mineral formulae, normative mineralogy and weathering indices

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Megascopic identification of minerals, microscopic study of rock forming minerals using optical accessories.	10
II	Preparation of thin section and polished section making, etching and staining. Instrumentation and analytical techniques.	10
III	Calculation of mineral formula of silicate minerals.	10
IV	Megascopic and microscopic studies of igneous rocks, calculation of CIPW Norms, Preparation of Variation diagrams. Rock/soil/sediments/water analysis in conjunction with practical listed for paper –V.	10
V	Calculation of mineral formulae from the concentration of various oxides in minerals, Calculation of normative mineralogy from rock composition,	10
VI	Calculation of weathering indices in soil and sediments. Presentation of analytical data.	10

Suggested Readings:

Program: **M.Sc.**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Sedimentology**	

Course outcomes (COs):
After completing the course, student
Will learn principles, origin structures sedimentary rocks and granulometric analysis
Will study texture, diagenesis and classification of sedimentary rocks
Will learn about facies, sedimentary environments and basins, and plotting of log
Will understand stratigraphy and sedimentation history of different sedimentary basins of India

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Principles of sedimentary processes origin and texture of sedimentary rocks, Earth Surface system	7
II	Liberation and flux of sediments, primary and secondary sedimentary structures.	8
III	Granulometric analysis, classification of clastic and non clastic sedimentary rocks,	8
IV	Shallow and deep water carbonates, Clay and Heavy mineral analysis	8
V	Sedimentary environments and facies; Continental – Alluvial – Fluvial, , Eolian, Lacustrine, Deposits.	8
VI	Marine continental-shelf, slope and rise deposits	7
VII	Sedimentation and Tectonics: Type of Geosynclines/Basins, provenances, lithification Diagenesis and cementation	7
VIII	Application of sedimentology, Preparation of lithologs and lateral diagrams, elementary idea about calcretes & palaesols..	7

Suggested Readings:

Allen, J.R.L., 1985: Principles of Physical Sedimentation George Allen & Unwin.
Allen, P., 1997: Earth Surface Processes. Blackwell publisher.
Davis, R.A.Jr., 1992: Depositional Systems. Prentice Hall.
Einsele, G., 1992: Sedimentary Basins. Springer Verlag.
Reineck, H.E. and Singh, I.B., 1980: Depositional Sedimentary Environments Springer-Verlag.
Prothero, D.R. and Schwab. F., 1996: Sedimentary Geology Freeman.
Pettijohn, F.J., Potter, P.E. and Siever, R., 1990: Sand and Sangstone Springer-Verlag.
Pettijohn's Sedimentology
D.R. Prothero, 2013, Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy. W. H. Freeman; Third edition
H.G. Reading, 2009, Sedimentary Environments: Processes, Facies and Stratigraphy. John Wiley & Sons.
S.M. Sengupta, 2018, Introduction to Sedimentology. CBS Publishers & Distributors Pvt. Ltd.
M. R. Leeder, 2009, Sedimentology and Sedimentary Basins: from Turbulence to Tectonics. John Wiley & Sons.
N.W. Gokhale, 2017, Fundamentals of Sedimentary Rocks. CBS Publishers & Distributors Pvt. Ltd.
H.E. Reineck, and I. B. Singh, 1980, Depositional Sedimentary Environments: With Reference to Terrigenous Clastics, Springer.
J.D. Collinson, and D.B. Thompson, 1988, Sedimentary Structures, Unwin Hyman, London.
D. R. Prothero, F. Schwab, 2004, Sedimentary Geology, Freeman
A.D. Miall, 1999, Principles of Sedimentary Basin Analysis. Springer Verlag, New York.
G. Nichols, 1999, Sedimentology and Stratigraphy, Blackwell publishing.
S. Boggs, 1995, Principles of Sedimentology and Stratigraphy, Prentice Hall, New Jersey.
D.S. Singh, 2018, Indian Rivers: Socio-economic aspects, Springer.

M.E. Tucker, 2006, Sedimentary Petrology. Blackwell Publishing.

Program: **M.Sc.**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Palaeobiology and Stratigraphy**	

Course outcomes (COs) :

After completing the course, student

Will know about preservation, history and evolution of fossils

Will know the morphology and evolution of mollusks, brachiopod, echinoderm & Trilobites

Will be able to determine the age of rock formation-based on fossils

Will learn the stratigraphic norms, biostratigraphy and different types of stratigraphic rocks

Will understand principles of Palaeogeography, Marine basins and life

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Fossils, Mode & preservation of fossils, index fossils, origin of life, major events in the history of Precambrian and Phanerozoic life.	7
II	Morphology and evolutionary trends in mollusks (Gastropoda, Bivalvia, cepholopoda), brachiopods, echinoderms and trilobites.	8
III	Evolution of man and Horse. Significance of micropalaeontology.	8
IV	Princeples & correlation of stratigraphy, stratigraphic code. Biostratigraphy: controlling factors zonation, time significance.	8
V	Prenciples of palaeogeography: - Marine basins and marine sediments, marine life, Bionomical zones. Continental basins, Palaeogeographic maps and their construction.	8
VI	Stratigraphy of important Indian succession, Indian sub continents: Vindhyan, Cuddapah Super group, lower palaeozoic of Kashmir, Kutch.	7
VII	Gondwana Super group: Classification, environment of deposition and economic importance; Siwalik super group and inter trappean beds.	7
VIII	Studies of Greenstone belt, evolution of important archean stratigraphic succession of Indian Shield – Dharwar, Bundelkhand Craton, Singhbhum Craton, Aravalli, and Bastar Craton	7

Sujjusted Readings:

Clarkson, E.N.K., 1998: Invertebrate Palaeontology and Evolution IV Ed. Blackwell.

Stearn, C.W. & Carroll, R.L., 1989: Palaeontology – the Record of life. John Wiley.

Smith, A.B.,1994: Systematics and the Fossils Record-Documenting Evolutionary Patterns, Blackwell.

Prothero, D.R., 1998: Bringing Fossils to life –An Introduction to Palaeobiology, McGraw Hill.

Pomerol, C., 1982: The Cenozoic Era: Tertiary and Quaternary. Ellis Harwood Ltd.

Goodwin, A.M., 1991: Precambrian Geology: The Dynamic Evolution of Continental Crust. Academic Press.

Boggs, Sam Jr., 1995: Principles of Sedimentology and Stratigraphy, Prentice Hall.

Doyle, P. and Bennett, M.R. 1996: Unlocking the Stratigraphic Record, John Wiley.

Brenner, R.E. and McHargue, T.R., 1988: Integrative Stratigraphy: Concepts and Applications, Prentice Hall.

Naqvi, S.M. and Rogers, J.J.W. 1987: Precambrian Geology of India, Oxford Univ. Press.

Pascoe, E.H., 1968: A Manual of Geology of India and Burma, Vol. I-IV, Govt. of India Press.

Ravindra Kumar's Stratigraphy

Naqvi S. M. 2005

Practical II (part-1):

Programme: **M.Sc**	Year:**First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Practical II (Sedimentology + Palaeobiology and Stratigraphy)**	

Course outcomes (COs)

Will learn the stratigraphic norms and presence of different types of stratigraphic rocks
Will understand fundamentals of stratigraphy and its branches.
Will be able to understand history of rocks

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Petrography of Clastic, non clastic rocks and megascopic identification of sedimentary rocks and structure.	10
II	Mechanical analysis of sediments and plotting of size distribution data, current rose diagram, thin section preparation, palaeo current analysis.	10
III	Study of important fossils and its importance in Geological studies.	10
IV	Correlation methods, land and sea distribution in Permian, Triassic, Jurassic, Cretaceous and Miocene periods.	10
V	Geochronological data and its interpretation in Precambrian Geology of India. Study of Important stratigraphic rocks of Indian sub-continent.	10
VI	Continental basins, Palaeogeographic maps and their construction	10

Suggested Readings:

Program: **M.Sc.**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Economic Geology**	

Course outcomes (COs):

After completing the course, student

Will identify the common ore and economic minerals.

will understand the genesis, physical and chemical processes involved in Ore formation

will understand the distribution and mode of occurrence metallic and nonmetallic minerals in India

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Modern concept of ore genesis; spatial and temporal distribution of ore deposits – a global perspective.	7
II	Comparison between Earth's evolutionary history and evolutionary trends in ore deposits. Ore deposits and plate Tectonics.	8
III	Mode of occurrence of ore bodies – morphology; and relationship of host rocks.	8
IV	Textures, structure, paragenesis and zoning of ores and their significance.	8
V	Concept of ore bearing fluids, their origin and migration; wall-rock alteration; control of ore localization.	8
VI	Introduction and genesis of important Ore Deposits related to Fe, Mn, Cr, Pb, Zn and Al.	7
VII	Introduction and genesis of important Ore Deposits related to Au and base metals.	7
VIII	Industrial minerals related to various industries. Non-metallic deposits: Fertilizers, building stones, Ceramic and glass.	7

Suggested Readings:

Craig, J.M. & Vaughan, D.J., 1981: Ore Petrography and Mineralogy. John Wiley.
Evans, A.M., 1993: Ore Geology and Industrial Minerals Blackwell.
Sawkins, F.J., 1984: Metal deposits in relation to plate tectonics. Springer Verlag.
Stanton, R.L., 1972: Ore Petrology, McGraw Hill.
Barnes, H.L., 1979: Geochemistry of Hydrothermal Ore Deposits. John Wiley.
Klemm, D.D. and Schneider, H.J., 1977: Time and Starta Bound Ore Deposits, Springer Verlag.
Guilbert, J.M. and Park, Jr. C.F., 1986: The Geology of Ore Deposits Freeman.
Mookherjee, A., 2000: Ore genesis – a Holistic Approach, Allied Publisher.

Program: **M.Sc.**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Metamorphic Petrology**	

Course outcomes (COs):
After completing the course, student
Will learn types, processes, classification and facies of Metamorphic rocks
Will study texture, structure, zones anatexis and origin of metamorphic rocks
Will understand the reactions, P-T conditions geothernometry, geobarometry, & geodynamic evolution

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Phase rule of closed and open systems, agents of metamorphism, types of metamorphism, metamorphic processes, deformation and recrystallisation.	7
II	Classification of metamorphic rocks, graphical representation (ACF, AKF, AFM Projection), facies concept.	8
III	A detailed description of low pressure metamorphic facies, medium to high pressure metamorphic facies and very high pressure metamorphic facies with special reference to characteristic metamorphic zones and subfacies.	8
IV	Metamorphic differentiation, anatexis and origin of migmatites in the light of experimental studies. Regional metamorphism and paired metamorphic belts in reference to plate tectonics, ultra – high temperature and oceanic floor metamorphism.	8
V	Nature of metamorphic reactions and pressure - temperature conditions of metamorphism isoreaction grads, schreinmakers rule and construction of petrogenetic grids.	8
VI	Concept of free energy, activity, fugacity and equilibrium constant, thermo dynamics of ideal, non ideal and dilute solutions, element partitioning in mineral formation and concept of simple distribution coefficients and exchange reaction distribution coefficients its uses.	7
VII	Pressure – temperature estimates, geothernometry, geobarometry, application & limitation of geothermobarometers.	7
VIII	Pressure – temperature – time paths and application in geodynamic evolution of metamorphic terrains.	7

Suggested Readings:

Turner, F.J., 1980: Metamorphic Petrology. McGraw Hill. New York.
Yardley, B.W. 1989: An Introduction to Metamorphic Petrology. Longman New York.
Philijpotts, A. 1992: Igneous and Metamorphic Petrology. Prentice Hall.
Kretz, R., 1994: Metamorphic Crystallization. John Wiley.

Practical II (part-2):

Programme: **M.Sc**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code:	Course Title: **Practical II (Economic Geology + Metamorphic petrology)**	

Course outcomes (COs):

After completing the course, student

Will learn techniques to identify ores & their physical, textural and optical characters.

Will study the physical and petrological characters of economic minerals

Will learn megascopic & microscopic study of metamorphic rocks

Will learn graphical representations of ACF, AKF and AFM diagrams and P-T conditions

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Megascopic study of structures and fabrics of different Ores and their associations.	10
II	Mineralogical and textural studies of common ore minerals under ore microscope	10
III	Petrological study of industrial and non industrial minerals.	10
IV	Sampling and determination of Tenor, cut-off grades and ore reserves.	10
V	Megascopic and microscopic studies of metamorphic rocks, Graphic construction of ACF, AKF and AFM diagrams,	10
VI	Estimates of P-T condition of metamorphism based on EPMA data.	10

Suggested Readings:

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Exploration and Mining Geology**	

Course outcomes (COs)::
After completing the course, student
Will learn geophysical exploration, magnetic properties of rocks and Resistivity & Seismic methods.
Will understand Geochemical exploration,Geo-botanical exploration and Mineral prospecting.
Will understand application of rock mechanics in mining, planning, exploration Drilling, shaft sinking, cross cutting, stopping, room and pillaring, top slicing, caving & Ore reserve estimation.

Credits:4	Course: **Core Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Geophysical Exploration: Principle of gravimeters, Geomagnetic field of the earth.	7
II	Magnetic properties of rocks. Working principle of magnetometers, application in exploration.	8
III	Resistivity method: basic principles, various types of electrode configurations. Application of electrical methods in ground water prospecting and civil engineering problems.	8
IV	Seismic methods: fundamental principles of wave propagation, retraction and reflection surveys for single interface, horizontal and dipping cases.	8
V	Geochemical exploration, Geo-botanical exploration, Mineral prospecting methods.	8
VI	Application of rock mechanics in mining, planning, exploration and exploratory mining of surface and underground mineral deposits	7
VII	Drilling, shaft sinking, drifting, cross cutting, winzing, stopping, room and pillaring, top slicing, sub-level caving and block caving.	7
VIII	Ore reserve estimation.	7

Suggested Readings:

Sharma, P.V., 1986: Geophysical Methods In Geology Elsevier.
Sharma, P.V., 1997: Environmental And Engineering Geophysics Cambridge Univ. Pres.
Vogelsang, D., 1995: Environmental Geophysics – A Practical Guide, Springer Verlag.
Dobrin, M.B., 1976: Intoduction To Geophysical Prospecting Mcgraw Hill.
Parasnis, D.S. 1975: Principles Of Applied Geophysics Chapman And Hall.
Stanislave, M., 1984: Intoduction To Applied Geophysics, Reidel Publ.
Krynine, D.H And Judd, W.R., 1998: Principles Of Engineering Geology, CBS Edition.
McKinstry, H.E., 1962: Mining Geology II Ed. Asia Publishing House.
Clark, G.B., 1967: Elements of Mining III Ed. John Wiley.
Aroghaswami, R.P.N., 1996: Courses in Mining Geology IV Ed. Oxford IBH.

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Environmental Geology**	

Course outcomes (COs):
After completing the course, student
Will understand abiotic and biotic components Atmospheric & Oceanic circulations,
Will understand the causes, effects and relief and remedial measures of Natural Hazards
Will understand the causes, effects of water pollution, Desertification and Cyclone
Will understand the effects of green house gases and Ozone depletion

Credits:4	Course: core course
Max. Marks: 30+70	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0	

Unit	Topics	No. of Lectures = 60
I	Definition and scope of environmental Geology, physical Environment; Lithosphere, Biosphere, Atmosphere and Hydrosphere.	7
II	Atmospheric & Oceanic circulations, Mass movement as hazard; types, causes, control and management.	8
III	Abiotic hazards; origin, mechanism, magnitude, risk assessment, prediction and management of earthquake. Important volcanic eruptions, mapping, monitoring and mitigation of volcanoes.	8
IV	Floods as hazards; magnitude and frequency of floods, Flood control and management, water logging problems due to construction of canals, reservoirs and dams.	8
V	Coastal hazard : waves cyclones, Tides Tidal floods, Tsunamis, coastal hazard and engineering structures, glacial and peri glacial hazards; Avalanches.	8
VI	Water pollution; surface water pollution, hazardous pollutants and treatment Ground Water pollution, pollutants and treatment	7
VII	Desertification, Causes, Dust storm, Cyclones/Anticyclones, Hurricanes and Thunder stroms.	7
VIII	Green house gases, Ozone depletion, Global warming, Environmental Laws.	7

Suggested Readings:

Valdiya, K.S., 1987: Environmental Geology – Indian Context. Tata Mcgraw Hill.
Keller, E.A., 1978: Environmental Geology, Bell And Howell, USA.
Bryant, E., 1985: Natural Hazards, Cambridge University Press.
Patwardhan, A.M., 1999: The Dynamic Earth System, Prentice Hall.
Subramaniam, V., 2001: Textbook In Environmental Science, Narosa International.
Bell, F.G., 1999: Geological Hazards Routledge, London.
Smith, K., 1992: Environmental Hazards Routledge, London.

Practical III (part-1):

Programme: **M.Sc**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Practical III (Exploration and Mining Geology+ Environmental Geology)**	

Course outcomes (COs):
After completing the course, student
Will learn Resistivity survey, properties of rocks Study of maps and models of engineering structures
Will understand Analyses for alkalinity, acidity, pH and conductivity (electrical) in water samples.

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Resistivity survey. Study of properties of common rocks with reference to their utility in engineering projects.	10
II	Study of maps and models of important engineering structures as dam sites and tunnels. Interpretation of geological maps for landslide problems.	10
III	Analyses for alkalinity, acidity, pH and conductivity (electrical) in water samples.	10
IV	Classification of ground water for use in drinking, irrigation and industrial purposes.	10
V	Presentation of chemical analysis data and plotting chemical classification diagram.	10
VI	Evaluation of environmental impact of air pollution groundwater, landslides, deforestation, cultivation and building construction in specified areas.	10

Suggested Readings:

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Hydrogeology**	

Course outcomes (COs):
After completing the course, student
Will learn the origin, distribution of ground water and hydrologic properties of rocks and aquifer
Will learn about chemical characteristics of ground water and techniques of well hydraulics
Will learn about recharge of groundwater, and uses of surface and groundwater

Credits:4	Course: **Elective**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Ground water origin, types, importance, occurrence, distribution of water in the Earth's crust.	7
II	Hydrologic properties of rocks: porosity, permeability, specific yield, specific retaention, hydraulic conductivity, transmissivity, storage coefficient. Ground water reservoirs – Aquifers, aqnicluedes, aquitards, aquifuge and types of aquifers. Hydrographs, water table contour maps.	8

III	Hydrogeological frame work of India, Groundwater in hard rocks and lime stone terrain with reference to Indian situation.	7
IV	Ground water quality, chemical characteristics of ground water in relation to various uses-domestic, industrial and irrigation purposes.	8
V	Well hydraulics: confined, unconfined, steady, unsteady and radial flow. Water level fluctuations: Methods of pumping test and analysis of test data, evaluation of aquifer parameters.	8
VI	Artificial recharge of groundwater, Consumptive and conjunctive use of surface and groundwater, problem of overexploitation, groundwater legislation.	7
VII	Water well technology: well types, drilling methods, construction, design, develoment and maintenance of wells. Salt water intrusion in coastal aquifers, remedial measures.	7
VIII	Surface and subsurface geophysical and geologiacal methods of groundwater exploration, hydrogeomorphic mapping using various remote sensing techniques.	8

Suggested Readings:

Todd, D.K., 1980: Groundwater Hydrology, John. Wiley.
Davies, S.N. & De Wiect, R.J.M., 1966: Hydrology, John. Wiley.
Freeze, R.A. & Cherry, J.A., 1979: Groundwater, Prentice Hall.
Fetter, C.W., 1990: Applied Hydrogeology, Merill Publishing.
Raghunath, N. M., 1982: Groundwater, Wiley Eastern.
Karanth, K.R., 1987: Groundwater Assessment Development and Management Tata McGraw Hill.
Alley, W.M., 1993: Regional Groundwater Quality, VNR New York.
Subramaniam, V., 2000: Water, Kingston Publ. London.

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Hydrogeological Modeling and Management**	

Course outcomes (COs):

After completing the course, student

Will learn history, evaporation, infiltration, railfall pattern and pollution in the Hydrological cycle,

Will learn River hydrology, Physical and hydrologic characteristics of lakes and reservoirs

Will learn hydrology of Wetlands and Watersheds and water quality of estuaries, Bays and Harbours

Credits:4	Course: **Elective**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Description of Hydrologic Cycle, Overview of application of hydrology, Historical aspects of development of hydrology	7
II	Evaporation and Evaporation Process, measurement, estimation of evaporation, Evapotranspiration, measurement and estimation of evapotranspiration, Infiltration process, infiltration indices and effective rainfall	8
III	Source and nature of water pollution, water quality standards, laws and regulations.	8
IV	Rivers and Streams: River hydrology and river pollution, point and non-point sources, initial mixing, oxygen demanding wastewaters, Streeter-Phelps model.	8
V	Lakes and Reservoirs: Physical and hydrologic characteristics, natural processes, water quality models, eutrophication, phytoplankton models, restoration and management strategy.	8
VI	Ground Water: natural ground water quality, sources and groundwater pollution, transport processes, non-aqueous phase liquids, remediation strategy.	7
VII	Wetlands and Watersheds: natural and constructed wetlands, wetland hydrology, water generated pollutant loads, urban and agricultural water sheds.	7
VIII	Estuaries, Bays and Harbours: Estuarine hydrology, tides and tidal currents, water quality in estuaries, water quality models.	7

Suggested Readings:

Reading:

1. Chin, David A., (2006),"Water Quality Engineering in Natural Systems", Wiley – Interscience.
2. Masters, G.M. and Ela, (2008),"Introduction to Environmental Engineering and Science", PHI Learning.
3. Thomann, R.V., Mueller, J.A., (1987), "Principles of Surface Water Quality Modelling and Control", Harper and Row Publishers.

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Fuel Geology**	

Course outcomes (COs):

After completing the course, student

Will understand origin of coal concept of 'maceral' and 'microlithotypes.

Will understand Rank, grade and type of coal, coal carbonization, coal gasification and coal hydrogenation.

Will understand the origin, nature and migration distribution and of oil and gas.

Will understand occurrence, source of energy of atomic minerals & Nuclear power stations of the country

Credits:4	Course: **Elective**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Definition and origin of coal. Macroscopic ingredients and microscopic constituents, concept of 'maceral' and 'microlithotypes.	7
II	Rank, grade and type of coal. Indian and international classifications. Chemical characterization : proximate and ultimate analysis	8
III	Preparation of coal for industrial purposes, coal carbonization (coke manufacture), coal gasification and coal hydrogenation.	8
IV	Application of coal petrology in hydropetrology in hydrocarbon exploration.	8
V	Geological and geographical distribution of coal deposits in India.	8
VI	Detailed geology for some important coalfields in of India. Coal production and problems of coal industry in India.	7
VII	Origin, nature and migration (primary and secondary) of oil and gas.	7
VIII	Mode of occurrence and association of atomic minerals in nature. Atomic minerals as source of energy and their deposits. Nuclear power stations of the country and future prospects. Atomic fuels and environment.	7

Suggested Readings:

Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., And Robert, P., 1998: Organic Petrology, Gebruder Borntraeger, 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, Gebruder Borntraeger, 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.

Program: **M.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Petroleum Geology**	

Course outcomes (COs):

After completing the course, student

Will learn composition, fractions and origin of Petroleum and gas.

Will understand the transformation of organic matter into kerogen, and its organic maturation.

Will understand the characters of reservoirs and traps and prospecting, drilling methods and basins.

Credits:4	Course: **Elective**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Petroleum: Its composition and different fractions.	7
II	Origin of Petroleum, nature and migration (primary and secondary) of oil and gas.	8
III	Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen.	8
IV	Characteristics of Reservoir rocks and Traps: structural, stratigraphic and combination.	8
V	Oilfield fluid – water, oil and gas occurrence.	8
VI	Prospecting for oil and gas, drilling and logging procedures.	7
VII	Oil-bearing basins of India and the world, Geology of the productive oilfields of India.	7
VIII	Position of oil and nature gas in India, future prospects and the economic scenario.	7

Suggested Readings:

Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., And Robert, P., 1998: Organic Petrology, Gebruder Borntraeger, Struttgart.

Holson, G.D. And Tiratsoo, D.H. 1985: Petroleum Formation And Occurrence, Springer-Verlag.

Selley, R.C., 1998: Elements Of Petroleum Geology, Academic Press.

Practical III (part-2)

Programme: **M.Sc**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code:	Course Title: **Practical III (Hydogeology/ Hydrogeological Modeling & Management + Fuel Geology/ Petroleum Geology)**	

Course outcomes (COs):

After completing the course, student

Will understand the analysis of contour maps and estimation of permeability &analysis of hydrographs.
Will study well logs, estimation of TDS & groundwater exploration using remote sensing techniques.
Will understand characters of coals, Completion of outcrops and calculation of coal reserves.
Will study geological maps and sections of important oilfields of India and world.

Will study estimation of infiltration capacity, Chemical analysis of water and modeling.
Will understand Study of geophysical well logs Water quality modeling using remote sensing techniques.
Will study geological maps and important oilfields of India and world & Calculation of oil reserves.

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
	Hydogeology : Delineation of hydrological boundaries on water-table contour maps and estimation of permeability. Analysis of hydrographs and estimation of infiltration capacity. Chemical analysis of water. Pumping test: time-draw down and time – recovery tests and evaluation of aquifers. Study of geophysical well logs. Estimation of TDS using resistively and SP logs. Exercises on groundwater exploration using remote sensing techniques.	
	Hydrogeological Modeling & Management : Delineation of hydrological boundaries on water-table contour maps and estimation of permeability. Analysis of hydrographs and estimation of infiltration capacity. Chemical analysis of water and modeling. Study of geophysical well logs. Estimation of TDS using resistively and SP logs. Exercises on water recourses and modeling using remote sensing techniques.	
	Fuel Geology: Megascopic characterization of banded coals. Proximate analysis of coal. Completion of outcrops in the given maps and calculation of coal reserves. Preparation of polished particulate mounts of coal. Megascopic and microscopic study of coals. Study of geological maps and sections of important oilfields of India and world. Calculation of oil reserves. Megascopic study of some uranium and thorium bearing minerals and rocks.	
I	**Petroleum Geology** : Models study and practical related to oil and gas traps: structural, stratigraphic and combination.	10
II	Study of geological maps and sections of important oilfields of India and world. Calculation of oil reserves.	10
III	Map studies on oil-bearing basins of India and the world, Geology of the productive oil fields of India.	10

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Engineering Geology**	

Course outcomes (COs) :
After completing the course, student
Will understand the physical and engineering properties of rocks and building stones.
Will understand the geological and geotechnical considerations of dams, tunnels and bridges.
Will understand the tunneling methods, mass movements and earthquakes designing of buildings

Credits:4	Course: **Core course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Role of engineering geology in civil construction and mining industry. Various stages of engineering geological investigation for civil engineering,	7
II	Physical and Engineering properties of rocks: rock discontinuities.	8
III	Physical characters of building stones. Metal and concrete aggregates.	8
IV	Geological consideration for evaluation of dams and reservoir sites. Dam foundation rock problems	8
V	Geotechnical evaluation of tunnel alignments and transportation routes.	7
VI	Methods of tunneling: classification of ground for tunneling purposes: various types of support.	7
VII	Mass movements with special emphasis on landslides and causes of hill slope instability.	7
VIII	Earthquakes and seismicity, seismic zones of India. Influence of geological conditions on foundation and design of buildings.	8

Suggested Readings:

Sharma, P.V., 1986: Geophysical Methods In Geology Elsevier.
Sharma, P.V., 1997: Environmental And Engineering Geophysics Cambridge Univ. Pres.
Vogelsang, D., 1995: Environmental Geophysics – A Practical Guide, Springer Verlag.
Dobrin, M.B., 1976: Intoduction To Geophysical Prospecting Mcgraw Hill.
Parasnis, D.S. 1975: Principles Of Applied Geophysics Chapman And Hall.
Stanislave, M., 1984: Intoduction To Applied Geophysics, Reidel Publ.
Krynine, D.H And Judd, W.R., 1998: Principles Of Engineering Geology, CBS Edition.
McKinstry, H.E., 1962: Mining Geology II Ed. Asia Publishing House.
Clark, G.B., 1967: Elements of Mining III Ed. John Wiley.

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Disaster Management**	

Course outcomes (COs):
After completing the course, student
Will understand scope, types, history and effects of hazards.
Will understand Vulnerability, Disaster Risk in India and world.
Will understand Global disaster risk, Disaster Management and Strategy for Disaster Reduction.

Credits:4	Course: **Core**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Introduction – the necessity of studying Disaster Management (DM); the scope for a Disaster Manager.	7
II	Disaster – Definition; Types of disasters; History of disasters; Components of disaster; Dimension of disasters; Phases of disaster.	7
III	Hazard – Definition; types of hazards; characteristic features, occurrence and impact of different types of hazards viz. natural hazards (including geo hazards), human induced hazards, environmental hazards, bio hazards; Hazard map of India.	8
IV	Vulnerability – Definition; Types of vulnerability – physical vulnerability, socioeconomic vulnerability, vulnerability related to gender and age, rural & urban vulnerability; Vulnerability analysis with special reference to India.	8
V	Disaster Risk – Definition; Significance; Factors of disaster risk; Disaster Risk analysis (with special reference to the Indian context) – Inter-relationship between Hazard, Vulnerability and Disaster Risk.	8
VI	Global disaster risk situation; Disaster risk situation of India; Hazard-Vulnerability maps of India; Case studies.	7
VII	Disaster Management – Definition; Components of DM; Crisis Management; Risk Management; Disaster Management Cycle; Impact of disaster on development.	7
VIII	United Nations International Strategy for Disaster. Reduction (UNISDR) mandate in Disaster Relief & Management; International Decade for Natural Disaster Reduction (IDNDR, 1990-2000); Yokohama Strategy and Hyogo Framework – a 'Paradigm shift' in disaster management policy (policy for reduction of disaster consequences); India's response to changes in DM Policy	8

Suggested Readings:

Practical IV (part-1):

Programme: **M.Sc**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Practical VI (Engineering Geology + Disaster Management)**	

Course outcomes (COs):
After completing the course, student

Will understand Resistivity survey and engineering properties of rocks.

Will understand Study of maps and models of important engineering structures

Will understand Natural and human Hazard maps of India

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	Resistivity survey.	10
II	Study of properties of common rocks with reference to their utility in engineering projects.	10
III	Study of maps and models of important engineering structures as dam sites and tunnels.	10
IV	Interpretation of geological maps for landslide problems.	10
V	Natural Hazard maps of India.	10
VI	Human Hazard maps of India	10

Suggested Readings:

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Medical Geology**	

Course outcomes (COs):
After completing the course, student
Will understand characters of tropical, subtropical environments, Public Health and Geological Processes
Will understand Pathways and Exposure and Water Hardness and Health Effects
Will understand Iodine and health Toxicity in the Environment

Credits:4	Course: **Elective**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	General characteristics of tropical, subtropical environments, arid zone, seasonally dry tropics and sub-tropics, humid tropics, and sub-tropics zone and mountainous zone.	7
II	Medical Geology- Perspectives and Prospects, Public Health and Geological Processes: An Overview of a Fundamental Relationship. Environmental Biology- Natural Distribution and Abundance of Elements, Anthropogenic Sources, Uptake of Elements on Chemical and Biological Perspective and its functions, Geological Impacts on Nutrition.	8
III	Pathways and Exposure- Volcanic Emissions and Health, Radon in Air and Water, Arsenic in Groundwater and the Environment. WHO and BIS Standards for drinking water. Fluoride in Natural Waters, soils, sediments, plants. Fluorides and health: Bioavailability of fluoride, Dental fluorosis, Skeletal fluorosis, Dental fluorosis in India, source, nature, cause and extent.	8
IV	Water Hardness and Health Effects, Geochemical basis for tropical endomyocardial fibrosis (EMF), Effect of water hardness on urinary stone formation (urolithiasis), Types of stones: Calcium oxalate, Calcium phosphate, Uric acid, Magnesium ammonium phosphate stones, Cysteine.	8
V	Iodine and health: The iodine cycle in the environment, Iodine in drinking water, Iodine in food, Iodine Deficiency Disorders (IDD), Endemic cretinism, Goitrogens .The nitrogen cycle, Nitrate as fertilizers and environment, Nitrogen loading in rice fields, Nitrates from human and animal wastes, Nitrates and health, Nitrates and Methemoglobinemia, Nitrates and cancer. Bioavailability of Elements in Soil	8
VI	Selenium Deficiency and Toxicity in the Environment, Soils and Iodine Deficiency, Natural Aerosolic Mineral Dusts and Human Health, Animals and Medical Geology. The Impact of Micronutrient Deficiencies in Agricultural Soils and Crops on the Nutritional Health of Humans.	7
VII	Environmental Toxicology, Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Speciation of Trace Elements.	7
VIII	Anthropogenic contamination of water and its remedial measures, Analytical Techniques and data interpretation	7

Suggested Readings:

Books Recommended C.B. Dissanayake and R.Chandrajith (2009). Introduction to Medical Geology, Springer, London H.Catherine, W.Skinner, Antony R. Berger(2003). Geology and Health: Closing gap, Oxford Univ. press, New York. Iosif F.Volfson (2010). Medical Geology: Current Status and Perspectives, 2010., Russian Geological Society (ROSGEO) Publisher. Moscow. K.S. Valdiya (2004). Geology, environment, Society, University press(India), Hyderabad. Lawrence K. Wang, Jiaping Paul Chen, Yung-Tse Hung, Nazih K. Shammas (2009). Heavy Metals in the Environment , CRS Press, Taylor & Francis Group, Boca Raton, FL M.M. Komatica, (2004) Medical Geology, Vol.2, Effects of geological environment on Human health , Elsevier, U.K. Oile Selinus, B. Elsevier(2003). Essentials of Medical Geology (2005), Acemedica Press., U.K. Oile Selinus, B. Finkleman, R.B., A.Jose (2010)

Medical Geology- Regional synthesis(2010), Springer, London. Scott S. Olson, (1999) International Environmental Standards Handbook , CRC Press, London.CKE William N.Rom, (2012). Environmental Policy and Public Health - Air Pollution, Global Climate Change, and Wilderness, by John Wiley & Sons, Inc. Published by JosseyBass A Wiley Imprint.
Mineralogy of Bones, Inorganic and Organic Geochemistry Techniques, Histochemical and Microprobe Analysis in Medical Geology.

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Earth Energy Resources**	

Course outcomes (COs):
After completing the course, student
Will understand Renewable and Non-Renewable Sources of Energy.
Will understand Types and Sources of Energy & Natural Oil and Gas, Coal and Nuclear Minerals.
Will understand the Wind, Wave and Biomass Based power and Energy
Will understand the Energy Sources and Remote sensing and GIS applications for Earth Energy Resources

Credits:4	Course: **Elective Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Definition of Energy: Primary and Secondary Energy. Difference between Energy, Power and Electricity.	7
II	Renewable and Non-Renewable Sources of Energy. The concept and significance 0f Renewability: Social, Economic, Political and Environmental Dimension of Energy.	8
III	Major Types and Sources of Energy Resources of Natural Oil and Gas, Coal and Nuclear Minerals.	8
IV	Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy	8
V	Energy Sources and Power Generation: Thermal, Nuclear, Hydroelectric, Solar, Wind and Wave; General Principles.	8
VI	Current Scenario and Future Prospects of Carbon Sequestration, coal Gasification and Coal Bed Methane (CBM).	7
VII	Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells.	7
VIII	Remote sensing and GIS applications for Earth Energy Resources mapping.	7

Suggested Readings:

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill
2. Global Energy Prospectives by Nebojsa Nakicenovic 1998, Cambridge University Press.
3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer
4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.
5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.
6. World Energy resources: C.E. Brown. 2001, Springer.
7. M. Dayal. (6th Ed). 1997. Renewable Energy: Environment and Development. Konark Pub. Pvt. Ltd.
8. S. Vandana. 2002. Alternative Energy. APH Publishing Corporation.
9. S. K. Agarwal. 2003. Nuclear Energy: Principles Practice and Prospects. APH Publishing Corporation.
10 P. Chaturvedi. 1995. Bio-Energy Resources. Concept Publications.
11. V S. Mahajan. 1991. National Energy: policy, crisis and growth. Ashish Publishing House.

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Quaternary Geology**	

Course outcomes (COs):

After completing the course, student

Will understand Quaternary stratigraphy, lithology, genesis of Quaternary deposits.

Will understand Paleogeography, Major climatic changes and Quaternary sea level changes

Will understand Atmospheric composition, ocean circulation, Paleoenvironments & Quaternary land forms

Credits:4	Course: **Elective Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	**Topics**	**No. of Lectures = 60**
I	Quaternary Geology - an overview. Quaternary environments.	7
II	Quaternary stratigraphy, lithology, genesis of quaternary deposits, fauna and flora	8
III	Paleogeography and economic importance of Quaternary resources.	8
IV	Major climatic changes during Quaternary period - Ice age, Pleis-tocene climate.	8
V	Quaternary sea level changes and coastal geo-morphology.	8
VI	Atmospheric composition, ocean circulation and biological processes during Quaternary.	7
VII	Quaternary fluvial, eolian and glacial systems. Paleoenvironments of Quaternary period in India.	7
VIII	Evolution of Quaternary land forms in India. Study of lake deposits and laterites of India.	7

Suggested Readings:

Text Books: Holmes, A. : Principles of Physical Geology, ELBS, U.K. Bird, E.C.F: Coastline changes. John Wiley & Sons, New York. Stowe, K. : Exploring Ocean Science: John Wiley, New York. Bloom, A.L.: Geomorphology - A Systematic Analysis of Late Cenozoic Landforms. PrenticeHall, New Delhi. Wadia et al : Quaternary environments and geoarchaeology of India. Geol. Soc. India, Bangalore. Thornbury, W.D. :Principles of Geomorphology, Wiley Eastern, New Delhi. Vaidyanathan, R. (ed) : Quaternary Deltas of India: Geol. Soc. India, Bangalore. Davis R.A. (ed) Coastal sedimentary environments. Springer Verlag, New York. Ahmad, E. : Coastal Geomorphology of India. Orient Longman, New Delhi. Leeder, M.R. : Sedimentary process and product: George Allen & Unwin, London

Program: **M.Sc.**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Advance Geomorphology**	

Course outcomes (COs):

After completing the course, student

Will learn geomorphic principles, geomorphological cycles, weathering and classification of soils.

Will understand Channel pattern, Flood plain, terraces and alluvial cones, hillslopes, tides and currents

Will understand Glaciers: types of glaciers and movement & Indo-Gangetic plain and Peninsula

Credits:4	Course: **Elective Course**
Max. Marks: 30+70	Min. Passing Marks: 40

Total No.of Lectures-Tutorials-Practical (in hours per week):L-T-P:3-0-0

Unit	Topics	No. of Lectures = 60
I	Introduction: geomorphic principles and processes. Theory of unformitarianism.	7
II	Control of geomorphological features by geological structuires, lithology, diastrophism, climate and time.	8
III	Geomorpological cycles. Rock weathering and soils: physical and chemical weathering. Karst topography	8
IV	Soil profile, classification of soils. Streams: hydrological cycle, transport of sediments, distribution of suspended sediments and different modes of sediment transportation, regime concept, erosional features.	8
V	The concept of grade, equilibrium and cycle of erosion. Channel pattern. Flood plain, terraces and alluvial cones.	8
VI	Morphometric studies. Hillslopes: forms relation to lithology and structural weakness in rock, environmental; control and mass movement, modification by overland flow of hillslopes. Desert: erosion, transportation and deposition by wind	7
VII	Oceans: waves, tides and currents, costal erosion and submergence. Glaciers: types of glaciers and movement. Crevasses, erosional features. Glacial and fluvoglacial deposits	7
VIII	Lakes: Classification and mode of formation. Geomorphic features of India: Extra-Peninsular region, Indo-Gangetic plain and Peninsula - their geomorphic evolution. Environmental geomorphology: elementary concept.	7

Suggested Readings:

Text Books W.D. Thornbury (1969) Principles of Geomorphology. Wiley Eastern Ltd. New Delhi. H.S. Sharma (1990) Indian Geomorphology. Concept Pub. Co., New Delhi. L.B.Leopold (1976) FluviaL processes in geomorphology. E.P.H.Publishing House, New Delhi. Duff, P.Mc L. D. (Ed) (1992) Holmes principles of physical geology. 4th edition, Chapman & Hall, London.

Robert S. Anderson and Suzzane P. Anderson (2010): Geomorphology - The Mechanics and Chemistry of Landscapes. Cambridge University Press.

M.A. Summerfield (1991) Global Geomorphology. Wiley & Sons.

Practical IV (part-2)

Programme: **M.Sc**	Year: **Second**	Semester: **Forth**
Subject: **Geology**		
Course Code:	Course Title: **Practical (Medical Geology/Earth Energy Resources + (Quaternary Geology/Advance Geomorpholoy)**	

Course outcomes (COs):
After completing the course, student
Will understand Chemical Analysis of data based on WHO and BIS Standards for drinking water.
Will understand Major Oil and Gas basins of India.
Will understand the Rank and classification of Coal and major deposits in India.

Credits:4	Core: **Compulsory**
Max. Marks: 100	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
I	**Medical Geology :** Chemical Analysis of data according to WHO and BIS	10
	Standards for drinking water.	10
II	Dental fluorosis, Skeletal fluorosis	
III	Iodine Deficiency Disorders	10
IV	Nitrates and Methemoglobinemia, Nitrates and cancer	10
V	**Earth Energy Resources** :	10
	Major Oil and Gas basins of India.	
VI	Megascopic studies to arrange Rank and classification of Coal and major deposits in India	10
	Study of rocks which associated Nuclear Minerals and major power stations in India	
I	**Quaternary Geology :** Reading topographic maps,	
II	Concept of scale Preparation of a topographic profile,	
III	Preparation of longitudinal profile of a river; Preparing Hack Profile;	10
IV	**Advance Geomorphology** :Calculating Stream length gradient index,	10
	Morphometry of a drainage basin, Calculating different morphometric parameters,	10
V	Preparation of geomorphic map , Interpretation of geomorphic processes from the	10
	geomorphology of the area	10
VI	Reconstruction and preparation of maps of Quaternary geology and environments	10

Suggested Readings: