

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMHAJINAGAR.**



CIRCULAR NO.SU/M.Sc.Geology/College/26/2024

It is hereby inform to all concerned that, the syllabus prepared by the Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, Academic Council at its meeting held on 08 April 2024 has accepted the **Second Year M.Sc. Geology (IIIrd and IVth semester) under the Faculty of Science & Technology as per National Education Policy-2020** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/3610-18
Date:- 08.07.2024.

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**Deputy Registrar,
Academic Section**

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] The Section Officer,[M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CHHTRAPATI SAMBHAJINAGAR



FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme in Science

(M. Sc.)

As per National Education Policy-2020

Effective From the Academic Year 2024-25

Course Structure and Curriculum

(Outcome Based Credit System)

Subject: GEOLOGY

(Effective From the Academic Year 2024-25)

*Chairman
A hoc Board*

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1. Preamble

National Education Policy (NEP) 2020 envisages Higher education plays an extremely important role in promoting human as well as societal wellbeing and in developing India. It expects that higher education must enable individual to study one or more specialized areas of interest at a deep level. The NEP also expects that higher education must prepare students for more meaningful and satisfying lives and work roles and enable economic independence. In view of this the new M.Sc. Geology program offered by the Dr. Babasaheb Ambedkar Marathwada University has been prepared as per the Credit Framework guidelines of National Education Policy (NEP) 2020.

This M.Sc. (Geology) Programme is of two academic years duration. These two years are divided into four semesters with the provision for exit at the end of first year. The evaluation of candidates will be done through various examinations under grade system during and at the end of each semester separately for theory and practical papers as per the credits offered by each course.

In M.Sc. (Geology) Programme is of total 88 credits, with 22 credits for each semester. Each semester is having three Discipline Specific Core (DSC) major courses along with their respective practical courses. Students have to choose one Discipline Specific Elective (DSE) along with its practical per semester from the list of Elective Course provided in pool/ basket. There will be a course related to skill or advanced technology in all these four semesters. Besides this there will be a course related to Research Methodology in First Semester. One course related to On Job Training (GEO/OJT/FP) in second semester that has to be completed by students in vacation period. There is one course known as Research Project RP-1 and RP-2 to be completed in III and IV Semester. The M.Sc. Geology programme includes various learning activities viz., assignment, student seminar, group discussion, reading classical papers; case study paper reading, blended learning, brainstorm discussion, collaborative learning, lectures, demonstration, practical with real specimens and at times with models. In addition to class-room teaching and laboratory practices, this program offers geological fieldwork. Students have to submit a field report to the Department based on the completed field training. Students should utilize the semester breaks for the geological field/internships/research projects, On Job Training /Internships in the nationally reputed institutes. Students will be evaluated through Continuous Assessment (CA) and Semester End Examination (SEE). The Research Project/Dissertation work is based on either new data generated for the proposed scientific problem OR based on available large global data sets using innovative ideas. Students must submit the thesis that will be based on sound methodology and well defined objectives. The Departmental Committee will develop the framework for research projects/dissertations and will be applicable to the course.

The M. Sc. Geology programme will enable students to develop deep level understanding and skills, they will also develop ability to acquire, analyze and interpret data generated in the laboratory or field, and can translate the results in the form of report. The students will be competent to work in various sectors of geoscience viz., government, and non-governmental organizations, PSU, industry, research and teaching, self-employment as well. The following pages of this document provide the structural framework, teaching scheme, evaluation schemes and the detailed contents of the syllabus.

2. Structure

Two-Year Post-graduate Program

Course and Credits distribution of two years/one year PG/Master's degree program
with entry & exit option

Faculty of Science & Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (after 3 years degree)
	II	3(4) +2=14	4		4 Complete during summer break		22	
Cum. Cr. for PG Diploma		28	08	4	4		44	
<i>Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits</i>								
Second Year 6.5	III	3(4)+2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4			6	22	
Cum. Cr. for 1 year PG Degree		26	8			10	44	
Cum. Cr. for 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

ABBREVIATION:

Major: A course, which should compulsorily be studied by the student as requirement of core or major subject is termed as a core course.

DSC: Discipline Specific Core

DSE: Generally, a course which can be chosen from a pool of course and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidates proficiency/skill is called as elective course.

OJT: On-the Job Training

FP: Field Project/Internship/Apprenticeship (Corresponding to the Major (Core) subject)

RP:-Research Project (Corresponding to the Major (Core) subject)

Note- Master Programme is based on DSC Specialization

**Illustrative Credit distribution structure for two years/one year programme
with multiple entry and exit options**

Class: M.Sc. First Year

Semester: I Semester

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits	Scheme of Examination			
			Theory	Pract.	Theory	Pract.		Theory Max. Marks 75		Practical Max. Marks 25	
								CA-40% Min/Max	SEE 60% Min/Max	CA 40% Min/Max	SEE 60% Min/Max
DSC Major Mandatory	GEO/MJ/500T	Mineralogy, Crystallography and Igneous Petrology	3	-	3	-	14	12/30	18/45	-	-
	GEO/MJ/501T	Metamorphic and Sedimentary Petrology	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/502T	Structural Geology and tectonics	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/503P	Practical based on GEO/MJ/500T	-	2	-	1		-	-	4/10	06/15
	GEO/MJ/504P	Practical based on GEO/MJ/501T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/505P	Practical based on GEO/MJ/502T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/506	Instrumentation and Analytical Techniques	-	4	-	2		-	-	8/20	12/30
DSE (Choose any one from pool of courses A/B/C with its respective practical)	GEO/DSE/507AT	A. Gemmology	3	2	3	1	04	12/30	18/45	04/10	06/15
	GEO/DSE/508AP	Practical based on GEO/DSE/507AT									
	GEO/DSE/507BT	B. Mapping Techniques									
	GEO/DSE/508BP	Practical based on GEO/DSE/508BT									
	GEO/DSE/507CT	C. Earth Science for Civil Engineers									
	GEO/DSE/508CP	Practical based on GEO/DSE/508CT									
RM	GEO/RM/509	Research Methodology	4	-	4	-	04	16/40	24/60	-	-
			16	12	16	06	22 credits	120	160	60	90

1. Major Mandatory (DSC) - Master Programme is based on DSC Specialization

- GEO/MJ/500T: Mineralogy, Crystallography and Igneous Petrology
 GEO/MJ/501T: Metamorphic and Sedimentary Petrology
 GEO/MJ/502T: Structural Geology and Tectonics
 GEO/MJ/503P: Practical based on Mineralogy, Crystallography and Igneous Petrology
 GEO/MJ/504P: Practical based on Metamorphic and Sedimentary Petrology
 GEO/MJ/505P: Practical based on Structural Geology and Tectonics
 GEO/MJ/506: Instrumentation and Analytical Techniques (**Practical**)

2. Discipline Specific Elective (DSE-Choose any one from pool of courses A/B/C with its respective practical)

- GEO/DSE/507AT: Gemmology
 GEO/DSE/508AP: Practical based on GEO/DSE/507AT Gemmology
 OR
 GEO/DSE/507BT: Mapping Techniques
 GEO/DSE/508BP: Practical based on GEO/DSE/507BT: Mapping Techniques
 OR
 GEO/DSE/507CT: Earth Science for Civil Engineers
 GEO/DSE/508CP: Practical based on GEO/DSE/507CT Earth Science for Civil Engineers

3. RM-1: Research Methodology

- GEO/RM/509: Research Methodology in Geology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits	Scheme of Examination			
			Theory	Pract.	Theory	Pract.		Theory Max. Marks 75		Practical Max. Marks 25	
								CA-40% Min/Max	SEE 60% Min/Max	CA 40% Min/Max	SEE 60% Min/Max
DSC Major Mandatory	GEO/MJ/550T	Stratigraphy and Palaeontology	3	-	3	-	14	12/30	18/45	-	-
	GEO/MJ/551T	Geochemistry and Ore Geology	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/552T	Geomorphology, Remote Sensing and GIS	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/553P	Practical based on GEO/MJ/550T	-	2	-	1		-	-	4/10	06/15
	GEO/MJ/554P	Practical based on GEO/MJ/551T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/555P	Practical based on GEO/MJ/552T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/556	Geological Field Work	-	4	-	2		-	-	8/20	12/30
DSE (Choose any one from pool of courses A/B/C with its respective practical)	GEO/DSE/557AT	A. Micropaleontology	3	2	3	1	04	12/30	18/45	04/10	06/15
	GEO/DSE/558AP	Practical based on GEO/DSE/557AT									
	GEO/DSE/557BT	B. Computer Applications in Geology									
	GEO/DSE/558BP	Practical based on GEO/DSE/557BT									
	GEO/DSE/557CT	C. Quaternary Geology									
	GEO/DSE/558CP	Practical based on GEO/DSE/557CT									
OJT/FP	GEO/OJT/559	On Job Training/ Field Project in Geology	-	4	-	4	04	-	-	16/40	24/60
			16	12	16	06	22 credits	120	180	100	150

1. Major Mandatory (DSC) - Master Programme is based on DSC Specialization

- GEO/MJ/550T: Stratigraphy and Palaeontology
 GEO/MJ/551T: Geochemistry and Ore Geology
 GEO/MJ/552T: Geomorphology, Remote Sensing and GIS
 GEO/MJ/553P: Practical based on Stratigraphy and Palaeontology
 GEO/MJ/554P: Practical based on Geochemistry and Ore Geology
 GEO/MJ/555P: Practical based on Geomorphology, Remote Sensing and GIS
 GEO/MJ/556: Geological Field Work (**Practical**)

2. Discipline Specific Elective (DSE-Choose any one from pool of courses A/B/C with its respective practical)

- GEO/DSE/557AT: Micropaleontology
 GEO/DSE/558AP: Practical based on GEO/DSE/557AT Micropaleontology
OR
 GEO/DSE/557BT: Computer Applications in Geology
 GEO/DSE/558BP: Practical based on GEO/DSE/557BT Computer Applications in Geology
OR
 GEO/DSE/557CT: Quaternary Geology
 GEO/DSE/558CP: Practical based on GEO/DSE/557CT Quaternary Geology

3. OJT/FP-1 GEO/OJT/559: On Job Training/ Field Project in Geology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits	Scheme of Examination			
			Theory	Pract.	Theory	Pract.		Theory Marks 75		Practical Max. Marks 25	
								CA-40% Min/Max	SEE 60%Min/Max	CA 40% Min/Max	SEE 60% Min/Max
Major Mandatory	GEO/MJ/600T	Hydrogeology	3	-	3	-	14	12/30	18/45	-	-
	GEO/MJ/601T	Geophysical Exploration	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/602T	Fuel Geology	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/603P	Practical based on GEO/MJ/600T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/604P	Practical based on GEO/MJ/601T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/605P	Practical based on GEO/MJ/602T	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/606	Geological Survey and Sampling Techniques	-	4	-	2	-	-	8/20	12/30	
DSC (Choose any one from pool of courses A/B/C with its respective practical)	GEO/DSE/607AT	A. Statistical Geology	3	2	3	1	04	12/30	18/45	04/10	06/15
	GEO/DSE/608AP	Practical based on GEO/DSE/607AT									
	GEO/DSE/607BT	B. Marine Geology and Climatology									
	GEO/DSE/608BP	Practical based on GEO/DSE/607BT									
	GEO/DSE/607CT	C. Watershed Development and Management									
	GEO/DSE/608CP	Practical based on GEO/DSE/607CT									
RP	GEO/OJT/609	Research Project-I	-	8	-	4	04	-	-	16/40	24/60
			12	20	12	10	22 credits	120	180	100	150

1. Major Mandatory (DSC)

GEO/MJ/600T: Hydrogeology

GEO/MJ/601T: Geophysical Exploration

GEO/MJ/602T: Fuel Geology

GEO/MJ/603P: Practical based Hydrogeology

GEO/MJ/604P: Practical based on Geophysical Exploration

GEO/MJ/605P: Practical based on Fuel Geology

GEO/MJ/606: Geological Survey and Sampling Techniques (**Practical**)

2. Discipline Specific Elective (DSE-Choose any one from pool of courses A/B/C with its respective practical)

GEO/DSE/607AT: Statistical Geology

GEO/DSE/608AP: Practical based on GEO/DSE/607AT Statistical Geology

OR

GEO/DSE/607BT: Marine Geology and Climatology

GEO/DSE/608BP: Practical based on GEO/DSE/607BT– Marine Geology and Climatology

OR

GEO/DSE/607CT: Watershed Development and Management

GEO/DSE/608CP: Practical based on GEO/DSE/607CT Watershed Development and Management

3. Research Project-1 - GEO/RM/609:

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits	Scheme of Examination			
			Theory	Pract.	Theory	Pract.		Theory Marks 75		Practical Max. Marks 25	
								CA-40% Min/Max	SEE 60% Min/Max	CA 40% Min/Max	SEE 60% Min/Max
DSC Major Mandatory	GEO/MJ/650T	Environmental Geology	3	-	3	-	14	12/30	18/45	-	-
	GEO/MJ/651T	Engineering Geology	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/652T	Mining Geology	3	-	3	-		12/30	18/45	-	-
	GEO/MJ/653P	Practical based on GEO/MJ/650	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/654P	Practical based on GEO/MJ/651	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/655P	Practical based on GEO/MJ/652	-	2	-	1		-	-	4/10	6/15
	GEO/MJ/656	Geological Fieldwork	-	4	-	2		-	-	8/20	12/30
DSE (Choose any one from pool of courses A/B/C with its respective practical)	GEO/DSE/657AT	A. Groundwater Exploration	3	2	3	1	04	12/30	18/45	4/10	06/15
	GEO/DSE/658AP	Practical based on GEO/DSE/657AT									
	GEO/DSE/657BT	B. Drilling and Logging									
	GEO/DSE/658BP	Practical based on GEO/DSE/657BT									
	GEO/DSE/657CT	C. Disaster Management									
	GEO/DSE/658CP	Practical based on GEO/DSE/657CT									
RP	GEO/RP/659	Research Project-2	-	12	-	-	06	-	-	16/40	24/60
			12	20	12	10	22 credits	120	180	100	150

1. **Major Mandatory (DSC) :**

GEO/MJ/650: Environmental Geology

GEO/MJ/651: Engineering Geology

GEO/MJ/652: Mining Geology

GEO/MJ/653: Practical based on GEO/MJ/650 Environmental Geology

GEO/MJ/654: Practical based on GEO/MJ/651 Engineering Geology

GEO/MJ/655: Practical based on GEO/MJ/652 Mining and Statistical Geology

GEO/MJ/656: Geological Fieldwork

2. **Discipline Specific Elective (DSE-Choose any one from pool of courses A/B/C with its respective practical)**

GEO/DSE/657AT: Groundwater Exploration

GEO/DSE/658AP: Practical based on GEO/DSE/657AT Groundwater Exploration

OR

GEO/DSE/657BT: Drilling and Logging

GEO/DSE/658BP: Practical based on GEO/DSE/657BT- Drilling and Logging

OR

GEO/DSE/657AT: Disaster Management

GEO/DSE/658: Practical based Disaster Management

3. **Research Project (RP) -2 - GEO/RP-2/699: Research Project in Geology**

3. Vision

To provide quality education and training to produce competent students to work for the national/international government/Non-government organizations, PSU and Self-employment in geoscience sector with high level knowledge, skills and confidence. Make them enable to contribute to science in general and nation economy in particular.

4. Mission

- To impart knowledge and skill for making student ready for future, department will make a systematic plan for using all the resources available in the department.
- To develop the attitude of analytical thinking in students through various activities throughout the programme, such as seminar, group discussion, blended learning, case study paper reading, reading classical papers, assignments, guided field visits, independent geological mapping, field projects, research projects, internship, practical with real specimens and exercises in laboratory, hands on training etc.
- To implement revised National Education Policy, and make systematic arrangements for learning and create learner friendly environment so that students will develop knowledge, skills and confidence to work for various organizations and for self-employment in this competitive world.

5. Programme educational Objectives

The objectives of this two year PG Programme is to cater the student a national level competitive syllabus and pedagogy, so that students will become successful in various competitive examinations related to geosciences as well as he will be also able to work in various sectors of geological sciences with high confidence especially in government, semi-government, PSU, and NGO. To make student so confident so that he/she can start his/her own NGO/ Self-employment.

6. Programme outcomes (POs) and Programme Specific Outcomes

6.1. M.Sc. Programme outcome (POs):

After completion of this Post Graduate program (M.Sc. Geology), students will be able to –apply to Union Public Service Commission's (UPSC) Geoscientists Examinations and they can join Geological Survey of India (GSI) and Central Ground Water Board (CGWB) as Geologist or Hydrogeologist.

Students will be eligible to apply for Graduate Aptitude Test in Engineering (GATE) for taking admission for Master's programs or direct doctoral programs in various IITs. The score of GATE is being considered valid for 3 years. GATE successful candidates become eligible for employment in Public Sector Undertakings (PSUs) such as Gas Authority of India Limited (GAIL), Indian Oil Corporation Limited (IOCL); National Thermal Power Corporation (NTPC), Nuclear Power Corporation of India Limited (NPCIL) and Oil and Natural Gas Corporation (ONGC). Direct Group 'A' level posts in Central Government, such as Senior Research Officer (S&T) in Cabinet Secretariat. Besides this some other government of India organizations have also expressed their interest to utilize GATE score for their recruitment purpose.

Students can also apply to Mineral Exploration Corporation Limited (MECL), Indian Bureau of Mines (IBM) and to specialized post of National Agricultural Banking and Rural Development (NABARD).

Students will also become eligible to apply for Maharashtra Public Service Commission's (MPSC) Examinations for the post of Geologist- Group B (Gaz). Successful candidates will be recruited in Groundwater Survey's and Development Agency (GSDA) and in Directorate of Geology and Mining (DGM).

Besides this, they will be eligible to apply for the post of Geologist in government or private mining companies such as metallic, non-metallic mines and Coal mines. Geotechnical soil and rock investigating agencies and oil exploration agencies are also recruiting M.Sc. Geology students as Geologists or as Mud loggers.

Students become eligible to apply for National Eligibility Test (NET), which enables students to go either for lectureship or for doctoral research depending on their merit and eligibility i.e. either Lecturership (LS) or Junior Research Fellowship (JRF) in various central and state universities, central or state research institutes. They become eligible to appear for State Eligibility Test (SET), which enables them to go for Lecturership in state universities.

Students can think about self-employment by establishing their own set up for Geological investigation such as hydrogeological surveys for selecting sites of bore-wells and dug-wells for irrigation and drinking purposes; They can start consultancy for geotechnical investigations, EIA and similar consultancy to various government or private mining companies. They can also start nongovernmental organization (NGO) which deals with water conservation and watershed development and its management.

6.2. Programme Specific Outcomes:

Students have to complete four semesters during their M.Sc. (Geology) Programme. Each semester is having three Discipline Specific Core (DSC) major courses and One Discipline Specific Elective (DSE) along with their practical respectively. There will be a course related to skill or advanced technology in all these four semesters. Besides this there will be a course related to Research Methodology in First Semester. One course related to On Job Training (GEO/OJT/FP) in second semester that has to be completed by students in vacation period. There is one course known as Research Project RP-1 and RP-2 to be completed in III and IV Semester. The outcome of each course of these courses is given in following table.

Course Learning Outcomes: Upon successful completion of this course, the student will be able to

Sr. No	Course Name and Code	Course outcome
1	Mineralogy, Crystallography and Igneous Petrology GEO/MJ/500 T	To understand about the concepts, structures, physical and chemical properties of minerals and their different groups. Structural formulae, classification, atomic structure, mode of occurrences and alterations of various minerals. To learn optical properties and concept of crystal, parameters, symmetry and classes of symmetry. To learn about magma, its genesis, composition, nature and evolution; Phase equilibrium of uni-component, binary, ternary and quaternary silicate systems; crystallization; Learn about various classifications of Igneous rocks; Students will get idea about Petrology, geochemistry and genesis of major igneous rocks types; students will learn about basaltic and granitic magmas; mid oceanic ridge volcanism, continental flood basalts, Deccan basalt, basalt magmatism associated with subduction zone.
2	Metamorphic and Sedimentary Petrology GEO/MJ/501T	To learn types of metamorphism; Depth zones, metamorphic grades; mineralogical phase rule and its application. Learn to understand the role of temperature, pressure and fluids in metamorphism; Metamorphic facies and subfacies; metamorphism various rocks; to understand metamorphic differentiation, metasomatism; anatexis and origin of migmatites; regional metamorphism and pair metamorphic belts in reference to plate tectonics. To get idea about ocean floor metamorphism, metamorphism related to ophiolites, metamorphism and continental collision; to understand the petrogenetic significance of textures and structures. This course will enable students to understand processes responsible for formation of various types rocks hosting economic minerals. To understand sedimentation, textures and structures and their importance, petrogenetic study, sedimentary facies and environments, diagenesis of major sedimentary rocks and their classification, paleocurrent analysis, etc, to understand Heavy Minerals and their Importance; students will get idea of palaeoclimate and palaeoenvironment analysis; Major diagenetic processes and diagenetic environments; Major Carbonate Minerals; Carbonate Grains of Biological origin.

		This course enables student to think about logical relationships between formation conditions of sedimentary rocks and fossil fuels, i.e. coal and hydrocarbon reserves. This knowledge enables students to work in oil industries.
3	Structural Geology and tectonics GEO/MJ/502T	<p>To find ores locations certain features are essential to find out in the field. This course gives knowledge regarding details of those features. Students will understand mechanical principles and properties of rocks and their controlling factors; theory of rock failure; concept of stress and strain in relation to analysis, types, ellipses and ellipsoids, their properties and geological significance; Students will also learn strain marks in natural and tectonics deformed rocks.</p> <p>Students will enable to understand details about folds, faults, fractures and joints and their mechanics; to classify all these features and find out age relationship and petrofabric analysis; to understand folding in shear zones; distribution of strains in folds; to understand how to do structural analysis of a terrain with multiple deformations.</p> <p>Besides this students will also understand concepts of geotectonic; details of continental and oceanic crust; tectonics of Precambrian orogenic belts of India; tectonic framework and seismicity of India.</p> <p>Will get an idea about mountain building and orogenic belts; structure and origin of the Alpine- Himalayan belt, Appalachian- Caledonian belt, Andes and North- American Cordillera. The knowledge of these features is basic requisite for a geologist.</p>
4	Research Methodology GEO/RM/509T	<p>Course Objectives:</p> <p>By the end of this course, students should be able to:</p> <p>To define, formulate research questions, develop research proposals and design experiments using appropriate methodologies.</p> <p>To apply statistical and computational tools for data collection, analysis, and interpretation.</p> <p>To provide insight into the processes that lead to oral presentations, use visual aids, adhering to ethical and professional standards.</p> <p>To be able to present, review and publish research findings through scientific writing.</p> <p>Course Outcomes:</p> <p>Upon successful completion of the "Research Methodology" course, students will be able to: Understand and explain research process,</p> <p>Do systematic literature survey; Formulate well-structured research questions, study design, and develop research proposals.</p> <p>Demonstrating a comprehensive understanding of various research methodologies.</p> <p>Collect suitable data and employ statistical and computational tools for data analysis, and interpret research findings effectively, ensuring accurate and reliable results.</p> <p>Communicate research findings through clear and concise scientific writing, oral presentations, and visual aids, adhering to ethical and professional standards, and effectively engage in the peer review process.</p>
5	Stratigraphy and Palaeontology GEO/MJ/550T	<p>To understand the concept of Geological time and Sequence stratigraphy and palaeogeography; brief ideas of quantitative-magneto-, seismic-, chemo- and event stratigraphy. Stratigraphic correlations and stratigraphic code.</p> <p>Students will be able to understand Precambrian stratigraphy of India including Dharwar Craton, Eastern Ghats Belt, Southern Granulite Belt and Singhbhum-Chhotanagpur-Orissa Belt. Proterozoic stratigraphy of Son-Valley, Cuddapah-Kurnool and Chatisgarh basins. Also have understanding on various stratigraphic boundary problems. Students will also understand stratigraphy and correlation of the Gondwana rocks; stratigraphy, facies, and fossil contents of the Palaeozoic rock formations of India. Palaeozoic of Himalayas; Mesozoics of Peninsular India; Tertiary rocks of India and their correlation; Cenozoic and Quaternary stratigraphy of India; Palaeogene and Neogene systems, Epoch boundaries of the Cenozoic in India.</p> <p>To understand the concept of origin and evolution of fossils, Collection, preparation, preservation and maintenance of palaeontological record; microfossils and their types - foraminifera, calcareous, nanno, silicious, phosphatic, organic walled. Students will understand the application of micropaleontology in ocean science, palynology and its application</p> <p>To identify fossils and describe specimens with the help of modern taxonomy; to understand ontogenic variation. They will be able to classify Brachiopoda, Bivalvia, Ammonoidea and Cindaria (corals); Able to understand evolutionary trends and geological history of various invertebrates. To learn about Palaeoecology/ Functional</p>

		<p>morphology of Bivalves and Brachiopods. Students can learn the concepts of evolution of fishes, equidae, elephant, dinosaur and man. To learn about trace fossils, their classification and their significance in paleo-environmental reconstruction.</p> <p>Students will be able to comment on the palaeoecology, sea level changes, biostratigraphy, relative ages of associated rocks and reasons behind the dispersal patterns of organisms from one part of continent to another.</p>
6	<p>Geochemistry and Ore Geology GEO/MJ/551T</p>	<p>To understand the concept of Geochemistry and Cosmochemistry. Chemical composition and properties of Earth's layers. To learn Concept of Atmosphere. Meteorites. Periodic table with special reference to rare earth elements and transition elements. To understand Gold- Schmidt geochemical classification. To learn Isotope geochemistry; kinds of isotopes; Radiogenic isotopes. Decay scheme of K-Ar, U-Pb, V-Pb, Sm- Nd and Rb-Sr; Radioactive dating of single minerals and whole rocks; Stable isotope geochemistry of Carbon and Oxygen and its application in Geology. Geochemistry of Uranium and Lithium. To understand about Eh and pH diagrams, oxidation and reduction in sedimentation. To get knowledge about Geochemical cycle-biogeochemical. Global climate; Composition of natural waters, river waters and ground water; concept of Biosphere and biogenic deposits.</p> <p>This course enables students to know about ore genesis, spatial and temporal distribution of ore deposits, relationship with plate tectonics, global occurrence of ore deposits, their host rocks, chemical composition, concept of ore-bearing fluids, their origin and migration; wall-rock alteration; Various controls of ore localization. To understand about Geothermometry and geobarometry of ore assemblage; texture, paragenesis and zoning of ores and their significance, organic matter in ores and their significance; to learn about petrological ore associations of Indian Orthomagmatic ores of mafic-ultramafic associations - diamond in kimberlite; REE in carbonatites; Ti- V ores; chromite and PGE; Ni ores; Cyprus type Cu- Zn ores of silicic igneous rocks- Kiruna type Fe- P; pegmatites; greisens; skarn.</p> <p>To understand ore of sedimentary and metamorphic affiliation; stratiform and stratabound ores deposits (Mn, Fe, non-ferrous ores); ore related to weathering-laterite, bauxite, Ni/ Au laterite. Students will get knowledge about Indian ore deposits, radioactive minerals and gemstones.</p> <p>This will help students in identifying ore bearing rocks during actual field or mining work for ore deposits in his professional life.</p>
7	<p>Geomorphology, Remote Sensing and GIS GEO/MJ/552T</p>	<p>To understand fundamental concepts of remote sensing; electromagnetic spectrum; spectral bands, resolutions and reflectance curves; interaction of EMR with atmosphere, rocks, minerals and soils; To know details about aerial photographs; To know about Satellite remote sensing; global and Indian space missions; different satellite exploration programs and their characteristics: LANDSAT, METEOSAT, SEASAT, SPOT and IRS; computer application in Remote sensing. Students will understand the satellite imageries their interpretation and applications; various other IRS products; To know the applications of remote sensing in groundwater exploration, petroleum exploration, engineering geology;</p> <p>Will learn about the concepts of dynamics of geomorphology; geomorphic processes and resulting landform; To get knowledge of geomorphic features of Maharashtra and geomorphology of Indian sub continents;</p> <p>Students will know about the geomorphological mapping based on genesis of landforms; morphometric analysis and modelling terrain evaluation for strategic purpose; To know the principles and applications of Geographic Information System.</p> <p>Over all students will learn modern laboratory tools and techniques and their uses before and during geological fieldwork.</p>
8	<p>A. Micropaleontology GEO/DSE/557AT</p>	<p>To learn about Sea floor life Introduction, classification of living organisms micropaleontology</p> <p>To study the lab techniques of microfossils samples preparation, thin sections, microfossil-faunal slides their identification light and SEM microphotography.</p> <p>To understand the study techniques and identification procedures of various microfossils; their geological distribution and applications with respect to India and world.</p>
9	<p>B. Computer Applications in Geology</p>	<p>To understand role of computers and software in geology, various types of geological database, modern geological research tools;</p>

	GEO/DSE/557BT	<p>Will learn about Geographic information systems, geospatial database, geospatial data collection, geo-referencing and digitizing geological features, interpretation, integration, correlation analysis techniques, thematic layers, spatial queries with geological database.</p> <p>Will understand about interface of ArcGIS, QGIS software, SAGA GIS, Interface of ERDAS IMAGINE programme, ENVI software, Coreldraw, MODFLOW software, IGIS, Global Mapper, Rockworks, Geochemist workbench; IXID Geophysical Resistivity Software.</p> <p>Will learn about generation of various geological maps using GIS and geological software, 3D modelling for geological visualization</p> <p>Will have introductory knowledge about coding and programming in geology, simulations for geological processes, python programming in geology, MATLAB coding in geology</p>
10	C. Quaternary Geology GEO/DSE/557CT	<p>Will know about the Quaternary as chrono-stratigraphic unit, Standard subdivisions of the Quaternary period and their climatic significance, standard global stratotype sections, Plio-Pleistocene boundary. The concept of local, regional and global climatic changes, the long term and abrupt changes during Quaternary with special emphasis to tropical-Subtropical climate.</p> <p>Will understand the mechanism of the Quaternary sedimentation over Indian sub-continent in relation to its climatic and/or tectonic controls.</p> <p>Will be able to draw stratigraphic relations of the Quaternary deposits in India with special emphasis on its regional and global correlations.</p> <p>Will understand about species-Climate relation and extinction during Quaternary period. Quaternary Geochronology and Stratigraphic Correlation methods.</p>
11	On Job Training/ Field Project in Geology GEO/OJT/559	<p>Student will be able to formulate a project and implement the knowledge he/she has gathered in first semester through Research Methodology paper. Students will be able to carry out the project under the guidance of faculty of the department. Or Students may opt for On the Job Training (OJT) and he can apply for this in different industries corresponding to geosciences to learn the applied aspects of the job at the respective industries.</p> <p>Students may also opt for Summer Internship and can apply for it in different Research Institutes/ Central/State organizations and get acquainted with applied aspects of the subject through experiential learning. The project reports will be evaluated as per university examination procedure and marks will be communicated to University.</p>
12	Hydrogeology GEO/MJ/600T	<p>Students will be able to understand concept of ground water and its movement and its vertical distribution; will understand various hydrologic properties of rocks. Students will have knowledge regarding groundwater quality parameters; hydrographs; hydrostratigraphic units, Darcy's Law; groundwater isotropy and anisotropy.</p> <p>Will be able to understand about wells and their inventory, well hydraulics; water level fluctuations; causative factors and their measurements; aquifers and their evaluation parameters.</p> <p>Will know about the groundwater legislation; problem of over exploitation of groundwater; salt water intrusion and remedial measures; pumping test.</p> <p>Will understand various methods of groundwater exploration; radioisotopes in hydrogeological studies, concept of watershed management,</p>
13	Geophysical Exploration GEO/MJ/601T	<p>Will be able to understand about concept of gravity, gravimeters; gravity field surveys and various corrections, preparation of gravity anomaly maps and their interpretation.</p> <p>Will understand Geomagnetic field of the earth; magnetic properties of rocks; magnetometers; Field surveys and quantitative interpretation; magnetic anomalies; concept of aeromagnetic surveys.</p>

		<p>Will understand about Resistivity, its survey methods; electrode configurations; field procedure profiling and sounding.</p> <p>Will be able to understand Seismic waves their propagation; refraction and refraction survey methods; Channel recoding of seismic data; End- on and split spread shooting techniques and interpretation of seismic data.</p>
14	Fuel Geology GEO/MJ/602T	<p>Students will be able to about Petroleum, its origin, migration; transformation of organic matter into kerogene; surface and subsurface occurrence.</p> <p>Will know characteristics of reservoir rocks and traps; Will be able to understand the stratigraphy, geology and petroleum aspects of oil-bearing basins of India;</p> <p>Students will know about origin of kerogen and coal; rank, grade and type of coal; Indian and International classifications of coal; macroscopic ingredients and microscopic constituents; concept of maceral and microlitho types.</p> <p>Will learn about methods of chemical characterization of coal by proximate and ultimate analysis; preparation of coal for industrial purposes by applying various processes. Concept of Coal bed – Methane: a new energy resource.</p> <p>Will know about atomic fuel- Mode of occurrence and methods of prospecting and productive geological horizons in India; nuclear power stations of the country and future prospects; Concepts of mud engineering, drilling fluids, gas sampling.</p>
15	Geological Survey and Sampling Techniques GEO/MJ/606	<p>Students will learn about Maps and their types; Toposheets, aerial photographs, satellite imagery; Use of toposheets for selection of sampling sites; interpretation of litho-log, Core-log; interpretation of geomorphological, geological, structural maps, hydrogeochemical maps. Sampling techniques for collection of -water, soil, rocks, and fossils. Thin section preparation, water quality analysis, sieve analysis, Techniques of separation of microfossils from matrix and picking of microfossils.</p>
16	Statistical Geology GEO/DSE/607AT	<p>Students will learn concepts of various statistical methods; mean; median and mode; standard deviation; skewness and kurtosis and their interrelationship; frequency distribution; coefficient of correlation and regression</p> <p>To understand the nature of geological data; scales of measurement; sample population; population distribution and population density function and their properties</p> <p>To understand the distribution of sample variance and chi square distribution; probability; testing normal distribution; students 't' test, 'f' test; confidence interval, analysis</p> <p>To know concepts and types of statistical models in geology; calculation of variance-covariance, simple linear models; cluster analysis.</p> <p>Will understand about graphical representation of statistical data and its interpretation.</p>
17	Watershed Development and Management GEO/DSE/607BT	<p>Students will learn the concept of watershed; understanding and interpretation of toposheet in respect of watershed; Geomorphology of watershed area; Groundwater Acts and Legislation.</p> <p>Will understand about groundwater provinces of India, groundwater quality map of India; water table contour maps; groundwater audit and budgeting;</p> <p>Will learn about hydrogeomorphic mapping using various Remote Sensing and GIS techniques. Renewable and non- renewable groundwater resources.</p> <p>Will be able to understand various methods of artificial groundwater recharge and rainwater harvesting; Water management in rural and urban areas.</p> <p>To understand concepts of land use and land cover; groundwater hydrogeomorphic units; Ground water management technical and social aspects.</p>
18	Marine Geology and	<p>Students will know the history of marine geology, scope and applications of marine geological investigations; introduction to oceanic petrology and micropaleontology, Coastal Zone Morphology (Estuaries, deltas, bays, raised beaches, features of wave erosion and deposition, tombolo, mud banks)</p>

	Climatology GEO/DSE/607CT	<p>To know the concept of ocean floor topography; Deep sea Morphology and fracture pattern.</p> <p>To understand the evolution of oceans, Sea floor spreading, Mid-oceanic ridges, submarine volcanism, and Tsunami.</p> <p>To understand atmospheric layers, insolation, long wave & short wave radiation, temperature variation, precipitation, humidity, air masses, atmospheric pressure, winds, atmospheric instability.</p> <p>To understand concept of climate classification, Koppen's and Trewartha climate classification, Cloud formation, types & classification.</p>
19	Research Project-1 - GEO/RM/609	<p>Research Project will be as decided and approved by the Departmental Committee- By doing the Research Project; students will be able to find out the problem based on the literature survey and formulate the project work schedule to find out solution for that problem. For this student will go through all the processes of Research activities.</p>
20	Environmental Geology GEO/MJ/650T	<p>Students will understand environmental dilemmas, fundamental concepts of environmental geology. Environmental protection – legislative measures in India</p> <p>To understand greenhouse gases, emission of CO₂, consequences, control and remedial measures for greenhouse gases; global warming.</p> <p>Will be able to understand the concept of earth system cycles in earth system- The energy cycle and the rock cycles.</p> <p>To understand the environmental impacts and assessment of mining, surface blasting, dumping of ores mine waste and fly ash etc.; Concept of soil profiles, texture, structure and soil degradation.</p> <p>To understand the surface water and groundwater contaminants and their impact assessment. remedial measures; water logging problems.</p>
21	Engineering Geology GEO/MJ/651T	<p>To understand the role of engineering geology in civil construction; engineering properties of rocks and soils; rock discontinuities; building construction material; aerial photography and its use in groundwater investigation; subsurface exploration.</p> <p>To understand geology of dams and reservoirs sites; classification of dams; dam foundation problems; reservoir problems.</p> <p>To understand geotechnical evaluation of- tunnels; tunnels, methods and design of tunnel; support in tunnelling; -roads, -bridges and bridge foundation, -airfields, -highways.</p> <p>To understand mass movements; landslides, causes of slides; stability of slopes; creep movement; earth flow and subsidence; precautionary measures and mitigations of hazards.</p> <p>To understand earthquake and seismicity; seismic zones of India; aseismic design of buildings; engineering problems related to precautionary measures and mitigations of hazards; beach engineering.</p>
22	Mining Geology GEO/MJ/652T	<p>To understand intersecting loci and ring targets; guides to ore localization. Methods of breaking rocks; Explosives used in mining.</p> <p>To understand surface mining methods and Underground mining methods; Subsidence and the support of mine excavation; timber as support and its treatment; drilling blast-holes; shaft sinking; mine drainage; ventilation.</p> <p>To understand methods of sampling; evaluation of a mineral deposit; Cost of mining; future costs and profits; life of mine; present value of mine and its determination by compound interest and Hoskolds' formula methods; amortisation; valuation of prospects: developed mines and working mines; valuation report.</p>
23	Geological Fieldwork GEO/MJ/656	<p>Geological Fieldwork will be as decided by the departmental committee; the goals of this field work are better understanding of the geological concepts and processes by visiting various terrains having special geological features; surface or underground</p>

		mines wherever possible in the field. To apply the knowledge in the field that acquired during theory and practical classes for proper observations and noting them for preparation of traverse map, geological sections and geological maps and their interpretations. Use all these observations for writing report of the visited field.
24	A. Groundwater Exploration GEO/DSE/657AT	<p>To understand surface methods for groundwater exploration; To understand Gravity method, gravity variation.Gravimeters. Field procedures. Corrections. Free-air & Bouger anomalies. Interpretation of anomalies.</p> <p>To understand Seismic method, Seismic waves propagation in rocks, critical refraction. Instruments and field procedures, interpretation of data. Application of seismic methods for groundwater exploration.</p> <p>To understand Electrical method, S.P method and its use. Resistivity, true and apparent D.C. resistivity, resistivity equipment, Electrode arrangement methods, field procedure and use for ground water exploration.</p>
25	Disaster Management GEO/DSE/657BT	<p>To understand- Natural Hazards occurring on the Earth's: catastrophic geological hazards; floods, tsunamis, landslides, earthquakes, volcanism and avalanches – with a view to assess the magnitude of the problem, prediction and perception of the hazards. Laws and regulations towards hazard management.</p> <p>To understand- earthquakes, seismic waves, intensity and magnitude, Richter scales; Tsunami; seismograph, seismogram-seismicity in Indian region, seismic gaps, mitigation measures and management. Plate boundary related earthquake. Preparation of seismic hazard map.</p> <p>To understand- Volcanoes-structure, types, global distribution - mitigation measures and management; Avalanche –types – mitigation; Flood- causes, vulnerable zones in India, coastal erosion – its causes-mitigation measures and management.</p> <p>To understand- Landslides- types -slow flowage, rapid flowage, sliding and subsidence, Cyclone – causes and mechanism - mitigation measures and management;</p> <p>To understand Mass movement – factor influencing slope stability – types of mass movement – hazards of mass movement – strategies for their reduction and the role of geology; Soil erosion –soil classification – factors influencing soil erosion – hazards of soil erosion; Drought – types, mitigation measures.</p>
26	C. Drilling and Logging GEO/DSE/657CT	<p>Students will know about geological aspects of drilling-types of drilling; drill rods and bits. Drilling methods; planning and selection of sites, angle and direction of bore-holes; Directional drilling; drilling fluids; water well drilling methods.</p> <p>To understand drilling and blasting patterns; types of drilling in surface and underground mining; Standard Penetration Test (SPT); concept of Deep Sea Drilling Project (DSDP) and JOIDES, ODP, IODP, JGOFS.</p> <p>To understand concept and principles of logging; Logging procedures-core logging and its interpretation; well-logging techniques- Borehole diameter; cross plotting; logging applications. Mud engineering, mud logging, drilling fluids, gas sampling; core / sludge recovery;</p>
27	Research Project in Geology GEO/RP-2/659	Research Project (RP) -2 - GEO/RP-2/699: Research Project in Geology –it will be as decided and approved by the Departmental Committee. By doing the Research Project, students will be able to find out the problem based on the literature survey and formulate the project work schedule to find out solution for that problem. For this student will go through all the processes of Research activities.

7. Eligibility

Students seeking admission in Master's degree course in Geology should have successfully completed three years B.Sc. Degree with Geology as one of the optional subject or students who have successfully completed four years in B.Sc. with Geology as one of the optional subject as per NEP2020.

8. Duration

1. Master's degree course in Geology would be of two years duration divided into four semesters having 22 credits for each semester. The course will have entry and exit option after completion of continuous one year of learning. In total the course is of total 88 credits. Where Discipline Specific Core (DSC) major mandatory courses of three credits of theory will be of one clock hour per week running for 15 weeks and one credit of practical course will consist of laboratory exercise based on the theory courses and will be of two hours per week running for 15 weeks. Besides this there will be a practical course of two credits of four hours per week comprising skill/ advance technique running for 15 weeks. There will be a basket/pool of Discipline Specific Elective Courses (DSE) having four credits that includes three credits of theory of one clock hour per week and one credit of practical of two clock hours per week running for 15 weeks. Students have to choose any one course from this DSE along with its respective practical. There will be courses to develop scientific aptitude among the students, from first to fourth semester of four to six credits of four to twelve hours per week running for 15 weeks. These are viz., Research Method, On-Job-Training/ Field Project, Research Project-1 and Research Project-2, Geological Field Work Tour, etc.
2. Student will have to earn 22 credits in each semester incorporated in the syllabus structure of Geology. Every student shall complete 88 credits in four semesters of M.Sc. Course. Students are allowed to complete M.Sc. course within 5 years.
3. Student who have taken admission in M.Sc. course after 3 years UG degree and desires to quit the course after successful completion of one year will get PG Diploma.
4. Student who have taken admission in M.Sc. course after 4 years UG degree and desires to quit the course after successful completion of two years will get PG Degree.

5. Credits:

1. One credit- one clock hour lecture in a week
2. Three credits lecture course in a semester means three lectures of one-hour each per week.
3. In a semester of 15 weeks duration = three credit lecture course is equivalent to 45 hours of teaching in a semester
4. A one credit course for-practical/lab work/community enjoyment program/filed work/seminar/internship /project in a semester means two-hour engagement per week.
5. In a semester of 15 weeks duration a one credit practical course is equivalent to 30 hours.
6. One Credit =25 Marks

9. Medium of Instruction

The medium of instruction for M.Sc. Geology course will be English.

10. Attendance

The students seeking admission to M.Sc. Geology course are hereby informed that they are supposed to adhere to the following rules:

1. A minimum of 75 % attendance for lectures /practical is the pre-requisite for grant of Terms.
2. There shall be theory test/ tutorial/ practical tests/seminar/ assignments etc. as a part of internal assessment in each semester.
3. The students are supposed to attend all the theory tests/ practical tests/seminars and submit the tutorial and assignments as decided by the department.

11. Evaluation Methods/Scheme of Examination

Evaluation of students:

There will be a uniform pattern of 40:60 for Continuous Assessment Test (CAT) and Semester End (SEE) theory examinations and practical examinations respectively.

a) Continuous Assessment:

Internal assessment for each course would be continuous and dates for each tutorials/ practical tests will be pre-notified. Departmental Internal Assessment Committee will coordinate this activity. Under Continuous Assessment (CA) scheme 40% evaluation of Theory and Practical courses will be done by the department and will be informed to university.

i) Theory Courses:

There will be 75 maximum marks for Semester end examination (SEE). Out of this 40% will be for Continuous Assessment (CA) i.e. 30marks, students should earn through Tests, seminars, Tutorials, assignments etc., and 60% will be for University Assessment i.e., 45 marks, students should earn through theory examination, that will be conducted by university.

There will be a minimum two tests in a theory course comprising of 30/40 marks and will compose multiple choice and or short/long answer questions or as decided by the department.

ii) Practical Courses:

Practical courses will be conducted at the term end and evaluated by external examiner in university practical examination. There will be 25/50/100 maximum marks for practical component. Out of 25 marks 40% (i.e.10/20/40 marks) will be for Continuous Assessment, for this, department will decide and develop appropriate process for evaluation and 60% (i.e.15/30/60 marks) will be for University Assessment.

iii) Field Project/ Research Project/ Field Work Components:

Fieldwork of is a compulsory component of the syllabi. The students are supposed to attend all field work tours organized by the Geology Department from time to time. This will include geological excursion/ field work/ field cum-laboratory workshops, visit to geologically important places, mines, geological and scientific organisations. Candidates should submit the field report at the end of excursion along with the geological specimens collected during the programme.

Field work for Field Project/ Research Project is compulsory. The evaluation will be based on performance of the student in the field, punctuality, enthusiasm and aptitude of students while completing the field work, sample collection, Tour Report/Project Report and Viva-voce

b) University Assessment:

The Semester end examination (SEE) will be conducted by university.

c) Minimum passing:

To pass in a paper and in the M.Sc. course, student should get 40% marks.

12. Curriculum for semester-I

M.Sc. GEOLOGY First Year (Semester I)

Theory Paper -GEO/MJ/500T

Mineralogy, Crystallography and Igneous Petrology

Marks:75

Credits: 03

UNIT I

Silicate structures of minerals; physical and chemical properties of minerals, Mineral Groups: Olivine, Garnet, Epidote, Pyroxenes, Amphiboles, Mica, Quartz and Feldspar; Non- Silicate Minerals.

UNIT II

Optical properties of Minerals; concept of uniaxial and biaxial indicatrix; optical accessories- quartz, mica and gypsum plate. Concept of symmetry, space lattice, crystal groups and their classes.

UNIT- III

Magma, Magmatic processes associated with evolution of magma. Crystallization of basaltic and granitic magma.

UNIT-IV

Phase diagram of unicomponent, binary (Solid-Solution, Eutectic and Peri-tectic system) and ternary systems. IUGS and CIPW classification of Igneous rocks.

UNIT V

Petrology, geochemistry and petrography of mafic ultramafic, alkaline rocks, ophiolites, carbonatites, lamprolite, kimberlite, pegmatites and lamprophyres.

Practical Paper GEO/MJ/503P

based on GEO/MJ/500T Mineralogy, Crystallography and Igneous Petrology

Marks: 25

Credits: 01

Study of rock- forming minerals in hand specimen; study of rock- forming minerals in thin sections; Study of Crystal Models. Study of igneous rocks in hand specimen with their structures and textures; study of igneous rocks in thin sections; Calculation of CIPW norms.

BOOKS RECOMMENDED- for Mineralogy and Crystallography.

1. Dana: Elements of Mineralogy
2. Deer, Howie and Zussman: Rock forming minerals
3. Kerr: Optical mineralogy
4. Winchell: Elements of Optical Mineralogy (Part I, II and III)
5. Wahlstrom: Optical crystallography
6. Phillipps: An introduction to crystallography
7. Barry and Mason: Mineralogy
8. Klein and Hubert: Manual of mineralogy
9. Spear, F. S.: Mineralogical phase equilibrium and Pressure Temperature- Time paths
10. Phillipps, W. R. and Guffen, D. T.: Optical mineralogy.'

Recommended Books for Igneous Petrology

1. Barth: Theoretical Petrology
2. Bowen: Evolution of Igneous Rocks
3. Bose: Igneous Petrology
4. Brain: Igneous Petrology
5. Mc Berney : Igneous Petrology
6. Best: Igneous Petrology
7. J. D. Winter: Principles of Igneous and Metamorphic Petrology
8. Turner and Verhoogan: Igneous and Metamorphic Petrology
9. Hatch, Wells and Wells: Petrology of Igneous rocks

**Theory Paper GEO/MJ/501T
Metamorphic and Sedimentary Petrology**

Marks: 75**Credits: 03****UNIT I**

Types of metamorphism; Role of temperature, pressure and fluids in metamorphism; Depth zones, metamorphic grades. Phase diagram of closed and open systems; application of phase rule. Metamorphic differentiation, metasomatism; anatexis and origin of migmatites;

UNIT II

Metamorphic facies with special reference to characteristic metamorphic zones and subfacies; Progressive, contact and regional metamorphism of quartzofelspathic, argillaceous and basic igneous rocks. Paired metamorphic belts in reference to plate tectonics; Ocean floor metamorphism; metamorphism related to ophiolites.

UNIT III

Processes of transport and formation of sedimentary rocks; classification of sedimentary rocks; sedimentary Textures, structures and their significance.

UNIT IV

Sedimentary facies and depositional environments: Continental, Marginal Marine and Marine; Origin, Petrography and Diagenesis of Sandstones, Mudrocks and Limestones.

UNIT V

Heavy minerals and their significance; palaeoclimate and palaeoenvironment analysis; Major diagenetic processes; Major Carbonate Minerals; Carbonate grains of Biological origin.

**Practical Paper GEO/MJ/504P based on GEO/MJ/501T
Metamorphic and Sedimentary Petrology**

Marks:25**Credits: 01**

Study of metamorphic rocks in hand specimen; study of metamorphic rocks in thin sections; structures and textures in metamorphic rocks; interpretation of reaction texture; plotting of chemical data on ACF, AKF and AFM diagrams.

Study of sedimentary rocks in hand specimen; study of sedimentary rocks in thin section; Study of grain-size by sieving method; Secondary and biogenic sedimentary structures in hand specimen; determination of porosity in

clastic and carbonate rocks; staining and mineral identification in carbonate rocks; Study of diagenetic features in thin sections.

BOOKS RECOMMENDED -for Metamorphic Petrology

1. Harker: Metamorphism
2. Turner: metamorphic Petrology
3. Winkler: Petrogenesis of metamorphic rocks
4. Miashiro: Metamorphism and metamorphic rocks
5. Turner and Verhoogan: Igneous and Metamorphic Petrology
6. Philipots: Igneous and Metamorphic Petrology
7. Bucher and Feg: Petrogenesis of metamorphic rocks

BOOKS RECOMMENDED -for Sedimentary Petrology

1. Allen, J.R.L: Principles of physical sedimentation
2. Nichols, G.: Sedimentology and Stratigraphy
3. Reading, H.G.: Sedimentary environments
4. Eincele, G.: Sedimentary basins
5. Miall, A.D.: Principles of sedimentary basin analysis
6. Tucker, M. : Techniques in Sedimentology
7. Reineck, H.R. and Singh, I.B.: Depositional sedimentary environments
8. Pomerol, C. : The Cenozoic Era: Tertiary and Quaternary

Theory Paper GEO/MJ/502 Structural Geology and Tectonics

Marks:75

Credits: 03

UNIT I

Concept of stress and strain; types of stress and strain ellipses and ellipsoids, their properties and geological significance.

UNIT II

Folds- Classification and mechanics of folding and buckling; structural analysis in terrain with multiple deformations.

UNIT III

Faults- Causes and dynamics of faulting; origin, types and significance. Fractures and Joints- Their nomenclature, age relationship, origin and significance.

UNIT IV

Fundamental concepts of geotectonic; recent advances, pros and cons; dynamic evolution of continental and oceanic crust; tectonic framework of India; seismicity in India.

UNIT V

Mountain building; Anatomy of the orogenic belts: Alpine- Himalayan belt, Appalachian-Caledonian belt and Andes.

Practical paper GEO/MJ/503/P based on GEO/MJ/502T Structural Geology and Tectonics

Marks:25

Credits: 01

Relation of structural- geology problems by orthographic and stereographic methods; Drawing of structural sections and interpretation of geological maps; graphical solutions.

BOOKS RECOMMENDED

1. Badgley, P.C. (1965): - Structure and Tectonics
2. Ramsay, S.G. (1967): - Folding and Fracturing of Rocks
3. Davis, G.R. (1984): - Structural Geology of Rocks and Region
4. Price, N.J. and Cosgrove, J.W. (1990): - Analysis of Geological Structures
5. Bayly, B.(1992): - Mechanics in Structural Geology
6. Moors, E. and Taiss, R.J. (1995) Tectonics
7. Keary, P and Vine, F.J. (1990); - Global Tectonics
8. Valdiya, K.S. (1998): - Dynamic Himalaya

Theory Paper GEO/RM/509T

Research Methodology

Marks: 100

Credits: 04

Course Description:

This course will familiarize students with comprehensive understanding of principles of research, research methods and research methodologies and procedures used to design, analyze, and report scientific research. The outcomes will equip students with the skills and necessary knowledge needed to design, conduct, analyze, present and effectively communicate research findings through clear and concise scientific writings.

Unit I: Introduction to Research Methodology, Research Ethics:

Fundamentals of Research; Types research; Research method, Research methodology. **Research Ethics:** Ethical guidelines for conducting research, Plagiarism and Self-Plagiarism.

Unit II: Literature search and review and Research Process:

Literature Review: Sources of information; literature reviews and identifying research gaps. Case studies, review articles.

Formulating Research Problem: Identifying research problems and formulating relevant research questions, Variables: Concepts, types; Measurement: Concept of measurement and scaling types; Hypothesis Concept – Qualities of a good Hypothesis – Null hypothesis and alternative hypothesis. Hypothesis testing.

Unit III: Research Design:

Research Design: Concept– Features of a good research design; Non-intervention: Exploratory research design – concept, Descriptive research designs – concept, Analytical design; Intervention: Experimental design- Concept, Quasi-experimental design; Before and after study design. Proposal submission for funding agencies

Unit IV: Data collection preparation and Processing

Data: primary and secondary data collection; Quantitative and Qualitative data; Data collection techniques and tools: Surveys, observations, sampling; Compilation of data: in tables, graphs, figures, maps, field and laboratory photographs etc.; Analysis of data: Quantitative and Qualitative data analysis. Statistical analysis and software applications.

Unit V: Communication and Presentation of Research

Scientific Writing: Report writing- importance, types, steps; abstract, research papers, reviews, synopsis, dissertation/thesis, preparation and submission of manuscript of research articles, peer review process.

Citations and Referencing: Using citation styles and publishers guidelines.

Scientific presentation: Oral and poster in Conference, Seminar, Colloquium, Workshops.

References:

1. Creswell John W. 2011. Research Design Qualitative, Quantitative and Mixed Methods Approaches-; SAGE Publications Ltd, UK, ISBN-9780857023452'
2. Creswell, J. W. 2014. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications.
3. Gerard Guthrie 2010. Basic Research Methods, SAGE Publications, India, Pvt Ltd, New Delhi, ISBN-10: 8132104579, ISBN-13:978-8132104575
4. Gupta S. L. and Gupta Hitesh 2013. Research Methodology, International Book House Pvt Ltd, ISBN-10: 191064278, ISBN-13: 978-8191064278
5. Hofmann Angelika 2010. Scientific Writing and Communication- Oxford University Press, US, ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
6. Joshua Schimel.2011. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded, Oxford University Press, ISBN: 9780199760237
7. Kothari C. R. 2011. Research Methodology-methods and techniques-, New Age International Publishers ISBN 978-81-224-1522-3
8. Phyllis G. Supino, Jeffrey S. Borer, 2012. Principles of Research Methodology, Springer, Verlag New York ISBN-ebook:1461433592, ISBN (Hardcover): 978-1461433590
9. Ranjit Kumar, 2010. Research Methodology- A Step-by-Step Guide for Beginners; Sage Publications Ltd, ISBN-1849203016.
10. Silverman, D. 2016. Qualitative Research. SAGE Publications.
11. Vijayalaxmi, G and Sivapragasam, C. 2008. Research Methods: Tips and Techniques
- YavuzOruc A. 2011. Handbook of Scientific Proposal Writing-; CRC Press, Taylor & Francis group, ISBN: 9781439869185

12. Curriculum for semester-II

Theory Paper GEO/MJ/550T Stratigraphy and Palaeontology

Marks: 75

Credits: 03

UNIT I

Approaches to measurements of Geological time. Concepts of Sequence stratigraphy; brief ideas of quantitative- magneto-, seismic-, chemo- and event stratigraphy. Approaches to palaeogeography. Stratigraphic correlations, stratigraphic code.

UNIT II

Precambrian stratigraphy, Precambrian geochronology. Chronostratigraphy of the Precambrian of Dharwar Craton, Eastern Ghats Belt, Southern Granulite Belt and Singhbhum-Chhotanagpur-Orissa Belt. Proterozoic stratigraphy of Son Valley, Cuddapah-Kurnool and Chatisgarh basins. Precambrian- Cambrian boundary.

UNIT III

Stratigraphy, facies and fossil contents of the Palaeozoic rock formations of India; Stratigraphy and correlation of the Gondwana rocks; Mesozoics of Peninsular India; Cretaceous-Tertiary boundary; Cenozoic stratigraphy of India, Palaeogene and Neogene systems, Epoch boundaries of the Cenozoic in India; Quaternary stratigraphy of India; Neogene- Quaternary boundary problem. Palaeozoic of Himalayas Permian-Triassic boundary.

UNIT IV

Origin and evolution of fossils, Modern Taxonomy, Identification of fossils, Describing a fossil specimen, Ontogenic variation. Classification of Brachiopoda, Bivalvia, Ammonoidea and Cnidaria (corals); Evolutionary trends and Geological history of Brachiopoda, Bivalvia, Gastropoda, Ammonoidea, Trilobita, Echinoidea and Cnidaria (corals). Palaeoecology/Functional morphology of Bivalves and Brachiopods. Evolution of fishes, equade, elephant, dinosaur and man.

UNIT V

Collection, preparation, preservation and maintenance of palaeontological record; microfossils; types of microfossils- foramenifera, calcareous, nano, silicious, phosphatic, organic walled, application of micropaleontology in ocean science, palynology and its application. Trace fossils: Kinds and classification; their significance in paleoenvironmental reconstruction.

Practical Paper GEO/MJ/553P based on GEO/MJ/550T Stratigraphy and Palaeontology

Marks: 25

Credits: 01

Exercises on stratigraphic classification and correlation; study of paleogeographic maps of all the geological periods; plotting of rock formations on maps; study of important genera of invertebrate, vertebrate and plant fossils; study of fossils in thin sections; study of microfossils.

Recommended books for Stratigraphy and Palaeontology

1. Krishnan, M. S.: Geology of India and Burma
2. Wadia, D.N.: Geology of India
3. Ravindrakumar: Historical Geology
4. Dunbar and Rogers: Principles of Stratigraphy
5. Krumbein and Sloss: Stratigraphy and Sedimentation
6. Willey, M. J.: Stratigraphic principles and practice
7. Naqui and Rodgers: Precambrian Stratigraphy of India
8. Swinerton: Outlines of Paleontology

Theory Paper GEO/MJ/551T Geochemistry and Ore Geology

Marks: 75

Credits: 03

UNIT I

Concept of Geochemistry and Cosmochemistry. Chemical composition and properties of Earth's layers. Concept of Atmosphere. Meteorites. Periodic table with special reference to rare earth elements and transition elements; Gold-Schmidt geochemical classification. Eh and pH diagrams, oxidation and reduction in sedimentation; Geochemical cycle- biogeochemical.

UNIT II

Isotope geochemistry; kinds of isotopes; Radiogenic isotopes. Decay scheme of K-Ar, U-Pb, V-Pb, Sm-Nd and Rb-Sr; Radioactive dating of single minerals and whole rocks; Stable isotope geochemistry of Carbon and Oxygen and its application in Geology. Geochemistry of Uranium and Lithium.

UNIT III

Modern concept of ore genesis; spatial and temporal distribution of ore deposits-global perspective; ore deposits and plate tectonics; concept of ore-bearing fluids, their origin and migration; wall-rock alteration; Texture, paragenesis and zoning of ores and their significance; mode of occurrence of ore bodies- morphology and relation of host rocks; structural, physiochemical and stratigraphic control of ore localization.

UNIT IV

Petrological ore associations with Indian examples wherever feasible: Orthomagmatic ores of mafic-ultramafic associations- diamond in kimberlite; REE in carbonatites; Ti-V ores; chromite and PGE; Ni ores; Cyprus type Cu-Zn ores of silicic igneous rocks- Kiruna type Fe-P; pegmatites; greisens; skarn. Indian ore deposits with reference to their mineralogy, mode of occurrence, origin, geological association and geographical distribution: iron, manganese, gold, aluminum, chromium, copper, lead, zinc, tin, tungsten, titanium, nickel, molybdenum; radioactive minerals and gemstones.

UNIT V

Geothermometry and geobarometry of ore assemblage; Organic matter in ores and their significance; stratiform and stratabound ores deposits (Mn, Fe, non-ferrous ores); ore related to weathering- laterite, bauxite, Ni/Au laterite. Ore of sedimentary and metamorphic affiliation.

Practical Paper GEO/MJ/554P based on GEO/MJ/551T Geochemistry and Ore Geology

Marks: 25

Credits: 01

Preparation and interpretation of geochemical maps; Rock/ sediments/ water/ soil analysis; Preparation of classificatory and variation diagrams, REE normalized plots and their interpretation.

Megascopic study of structures and fabrics of different ores and their associations; mineralogical and textural studies of common ore minerals under petrological microscope and ore microscope; determination of elemental composition of minerals and rocks by flame photometer and atomic absorption spectrometer; preparation of thin sections and polished sections.

BOOKS RECOMMENDED-for Geochemistry.

1. Mason, B. and Moore, C.B.: - Introduction to Geochemistry
2. Faure, G.: - Principles of Isotope Geology
3. Hoefs, J.: - Stable Isotope Geochemistry
4. Marshall, C.P. and Fairbridge, R.W.: - Encyclopedia of Geochemistry
5. Govett, G. J.S.: - Handbook of Exploration Geochemistry
6. Kraustopf, K.B.: - Introduction to Geochemistry

BOOKS RECOMMENDED -for Ore Geology.

1. Craig and Vaughan (1981): - Ore Petrography and Mineralogy
2. Evans (1993): - Ore Geology and Industrial Minerals
3. Sawkins (1984): - Metal Deposits in Relation to Plate Tectonics
4. Klemm and Schneider (1977): - Time and Strata-bound Deposits
5. A.M. Evans (1987): - An introduction to ore geology
6. Park and Mac Diarmid (1975): - Ore deposits

Theory Paper GEO/MJ/552T Geomorphology, Remote Sensing and GIS

Marks: 75

Credits: 03

UNIT I

Fundamental concepts of remote sensing; Types of Remote Sensing; general idea about electromagnetic spectrum; spectral bands, resolutions and reflectance curves; interaction of EMR with atmosphere, rocks, minerals and soils; aerial photographs and their geometry; recognition of photo-elements; recent advancement and application

UNIT II

Satellite remote sensing; global and Indian space missions; different satellite exploration programs and their Characteristics: LANDSAT, METEOSAT, SEASAT, SPOT and IRS; visual interpretation of satellite images; computer application in Remote sensing.

UNIT III

Imageries and IRS products; Role of Remote sensing in Geosciences; use of satellite images in monitoring natural hazards and environment.

UNIT IV

Dynamics of geomorphology; geomorphic processes and resulting geomorphic landforms & their features and geomorphology of Indian sub continents;

UNIT V

Hydrogeomorphic Units; Morphometric analysis; principles and applications of Geographic Information System.

Practical Paper GEO/MJ/555P based on GEO/MJ/552T Geomorphology, Remote Sensing and GIS

Marks: 25

Credits: 01

Study and nature of aerial photographs resolution, mosaics, symbols, gully pattern and drainage analysis, image parallax; determination of scale, height, dip, slope, vertical exaggeration and image distortion; detailed study of Satellite imageries; GIS software and its applications.

RECOMMENDED BOOKS

1. Miller (1961): Photogeology
2. Sabbins (1985): Remote Sensing- Principles and Applications
3. Ray (1969): Aerial Photographs in Geological Interpretations
4. Drury (1987): Image Interpretation in Geology
5. Moffitt and Mikhail (1980): Photogrammetry
6. Lillesand and Kieffer (1987): Remote Sensing and Image Interpretation
7. Pandey S.N. (1987): Principles and Application of Photogeology
8. Gupta (1990): Remote Sensing Geology
9. Thornbury: Principles in Geomorphology
10. Summerfield (2000): Geomorphology and Global Tectonics
11. Holmes. A. (1972). Principles of Physical Geology The English Language Book Society and Nelson

12. a. Curriculum for Discipline Specific Elective (DSE): Semester-I

Discipline Specific Elective (DSE): (Choose any one from pool of courses A/B/C with its respective practical)

Theory Paper GEO/DSE/507AT: Gemmology

Marks: 75

Credits: 03

Unit I

Introduction and scope of Gemology; Crystallography of gems/gemstone; Interior of Earth's; Geological Activities; Formation and occurrences - Geology related to gemstone minerals.

Unit II

Gemstone: Types, physical and optical properties of gems/gemstones; Types of gemstones; 4C's of Gems; Gemological Instrumentations: Gemological Microscope; Polariscope; Refractometer; Eye loops; Dichroscope and its applications for Gemstone/gems identifications

Unit III

Synthetic gemstones; History of early gemstone synthesis, Gemstone synthesis process: Flame fusion (Verneuil Process), Czochralski (Crystal pulling), Skull melting process, Flux fusion process, Hydrothermal process, Gel growth, Ceramic process.

Unit IV

Treatment on Gemstones: Bleaching, Coating, Spraying and Foiling, Impregnation with oil, resin, Fracture filling; Dyeing, Heat treatment, Surface coating; Diffusion treatment; High pressure and high Temperature; Glass filling; Laser Drilling.

Inclusions and its causes; Special optical effects due to inclusion- Opalescence; Adularescence; Iridescence; Asterism; Chatoyancy; Types of inclusions occur in gems.

Unit V

Gemstone cutting and polishing methods; Different cut of gems and their cutting style; Gemstones mines; Gemstone certification or valuations; Uses of gems in jewellery.

Practical Paper GEO/DSE/508AP: based on GEO/DSE/507AT- Gemmology**Marks: 25****Credits: 01**

Physical and Optical properties of gems/ gemstones; Identification of Natural or synthetic gems/ gemstones; Calculation of the refractive indices of different gems using Refractometer; 4 C's of Navaratna stones. Identification of the treatment process on gems.

OR

Theory Paper GEO/DSE/507BT: Mapping Techniques**Marks: 75****Credits: 3****Unit I**

Preparation for field work, Instruments and equipments for field; Geological symbols; Report writing.

Unit II

Map, Classification of maps, General map reading, Scales of maps, Contours, Direction, Scale and distance measurement, Topographical map numbering.

UNIT III

Traverses- Reconnaissance and detailed mapping, geological maps, Geochemical, Geophysical maps, thematic maps and their scale.

Unit IV

Surveying, Section Measurement, Structural Mapping, Prospecting-Geological, Geochemical, Geobotanical and Geophysical

Unit V

Sampling; rock, ore and water sampling techniques; Borehole sampling and their evaluation.

**Practical Paper GEO/DSE/508BP
based on GEO/DSE/507BT-Mapping Techniques****Marks: 25****Credits: 01**

Map reading and interpretation, Drawing xy section, soil sample, water sample, drill core sample, sample preparation, Thin section making from various rocks.

BOOKS RECOMMENDED

1. J.W. Barnes: Basic Geological Mapping
2. F. H. Lahee: Field Geology (<https://archive.org/details/in.ernet.dli.2015.280037/page/n687/mode/2up>).
3. Robert, R. Crompton: Manual of Field Geology (<https://indianculture.gov.in/ebooks/manual-field-geology>)
4. K.R. McClay: The mapping of Geological structures.
5. Richard J Lisle: Geological Structures and Maps- A Practical Guide.

OR

Theory Paper GEO/DSE/507CT: Earth Science for Civil Engineers**Marks: 75****Credits: 03****UNIT I**

Role of geology in civil construction; Geological time scale; Geology of India and Maharashtra; Field characters of Deccan basalts

UNIT II

Basalts, morphology of basalt; Field characters of Deccan basalts; Regional distribution of Deccan traps. Geology of Precambrians; Gondwanas.

UNIT III

Dykes in Deccan traps and in granites; Geological aspects of following on engineering structures: Deccan Traps, Precambrian rocks, Gondwana –Sedimentary rocks; Alluvium/Soil

UNIT IV

Case histories related to dam sites, tunnels, bridges and other engineering structures of India. Percolation Tanks and their feasibility and success .

UNIT V

Geological aspects of watershed management; City planning and Geology. Earthquake and seismicity; seismic zones of India;

BOOKS RECOMMENDED

- 1.Krynine and Judd: Principles of Engineering Geology;
- 2.Richeny, J.E.: Elements of Engineering Geology
- 3.Lagget: Geology and Engineering;
- 4.Trefethen, Joseph- Geology of Engineers
- 5.Gupte, R: Textbook of Engineering Geology

Practical GEO/DSE/508CP based on GEO/DSE/507CT- Earth Science for Civil Engineers

Marks: 25

Credits: 01

Identification of rocks in hand specimens, Identification of rocks in thin section specimens, L- Sections, Study of models

Theory Paper: GEO/DSC/557AT Micropalaeontology

Marks: 75

Credits: 03

UNIT I

Sea floor morphology and life Introduction, History of development of micropaleontology, classification of living organisms,

UNIT II

Collection of samples, Sample preparation for microscopic study. Laboratory studies of thin sections, faunal slides, sorting and picking of microfossils. Identification of microfossils using light microscope; SEM microphotography.

UNIT III

Introduction of microfossils; Preparation of samples and study techniques; morphology, classification, ecology of:- foraminifera-, diatoms, ostracoda, calcareous nannofossils, Conodonts; their geological distribution and applications with respect to India and world.

UNIT IV

Organic Walled Microfossils: Introduction. Acritarchs and Chitinozoa; Dinoflagellates; Spores and Pollens.

UNIT V

Calcareous algae (Rhodophyta and Chlorophyta): Broad classification, morphology and internal structure; significance of calcareous algae.

Practical Paper GEO/DSE/558AP based on GEO/DSE/557AT Micropalaeontology

Marks: 25

Credits: 01

Techniques of separation of microfossils from matrix; Study of morphological characters of various benthic and planktic fossils like -Foraminifera, Calcareous Algae; Preparation of oriented sections of larger benthic foraminifera. Exercises on Biostratigraphy and interpretations. Study of microfossil assemblages from various geological formations and interpretation of environment, geological age.

BOOKS RECOMMENDED :

1. Agashe, Shripad N., 1995. Paleobotany, Oxford and IBH Publ., New Delhi. Stewart,
2. Armstrong, H. and Brasier, M.D., 2005. Microfossils. Blackwell Publishing.
3. Arnold, 2002. Quaternary Environmental Micropaleontology (Ed. Simon K. Haslett), Oxford University Press, New York.
4. Bignot, G., 1985. Elements of Micropaleontology. Graham and Trotman.

5. Glaessner, M.F., 1945. Principles of Micropaleontology. Hafner Publishing Company.
6. Haq, B.U. and Boersma, A., 1998. Introduction to Marine Micropaleontology. Elsevier.
7. Jones, D.J., 1969. Introduction to Microfossils. Hafner Publishing Company, New York.
8. Jones, R.W., 1996. Micropaleontology in Petroleum Exploration. Oxford.
9. Kathal, P.K., 1997. Microfossils and their applications. CBS Publishers and Distributors.
10. Kathal P.K., 2012 Applied Geological Micropaleontology, Scientific Publishers India.
11. Martin, R.E., 2000. Environmental Micropaleontology. Springer.
12. Wray, J.L., 1977. Calcareous Algae, Elsevier. London

Theory paper: GEO/DSE/557BT Computer Applications in Geology

Marks: 75

Credits: 03

Unite 1

Role of computers and software in geology, computer hardware and software essentials for geologists, overview of geological software, introduction to modelling, and visualization, various types of geological database, significance of computer based analysis of geological database, modern geological research tools

Unite II

Geographic information systems, geospatial database, geospatial data collection, geo-referencing and digitizing geological features, interpretation, integration, correlation analysis techniques, thematic layers, spatial queries with geological database

Unite III

Introduction and interface of ArcGIS, QGIS software, SAGA GIS, Interface of ERDAS IMAGINE programme, ENVI software, Coreldraw, MODFLOW software, IGIS, Global Mapper, Rockworks, Geochemist workbench; IXID Geophysical Resistivity Software.

Unite IV

Generation of geological maps using GIS and geological software, cross-sections and contour maps, 3D modelling for geological visualization

Unite V

Introduction of coding and programming in geology, simulations for geological processes, python programming in geology, MATLAB coding in geology

BOOKS RECOMMENDED:

1. Geological Data Analysis: A Computational Approach by Vladimir Tolstoy and Oleh T. Babak
2. Geographic Information Systems in Geology- Fred G. Bell
3. Remote Sensing and Image Interpretation Book by Ralph W. Kiefer and Thomas Lillesand
4. ArcGIS for Desktop: An Introduction by Wilpen L. Gorr and Kristen S. Kurland
5. Practical Geostatistics- Isobel Clark and William V. Harper
6. Python Crash Course- Eric Matthes
7. MATLAB for Engineers- Holly Moore
8. Applied Groundwater Modeling: Simulation of Flow and Advective Transport- Mary P. Anderson and William W. Woessner

Practical GEO/DSE/558BP based on GEO/DSE/557BT- Computer Applications in Geology

Marks: 25

Credits: 01

Geo-referencing, image enhancement, digitization, creation of thematic layers, interpretation, integration, DEM generation, 3D modelling, python programming, MATLAB coding, hands on ArcGIS, QGIS software, SAGA GIS, ERDAS IMAGINE programme, ENVI software, Coreldraw, and MODFLOW software.

Theory paper: GEO/DSE/557CT Quaternary Geology

Marks: 75

Credits: 3

UNIT I

Quaternary as chronostratigraphic unit, Standard sub-divisions of the Quaternary period and their climatic significance,

UNIT-II

standard global stratotype sections, Plio-Pleistocene boundary. The concept of local, regional and global climatic changes, the long term and abrupt changes during Quaternary with special emphasis to tropical-Subtropical climate.

UNIT III

An overview of the processes and mechanism of the Quaternary sedimentation over Indian sub-continent in relation to its climatic and/or tectonic controls.

UNIT-IV

Stratigraphic relations of the Quaternary deposits in India with special emphasis on its regional and global correlations.

UNIT-V

Climate adaptability and extinction of species during Quaternary period. Quaternary Geochronology and Stratigraphic Correlation methods.

Practical paper GEO/DSE/558CP based on GEO/DSE/557CT- Quaternary Geology

Marks: 25

Credits: 01

Study of quaternary sediments, Preparation of Quaternary geological maps; Calculation of ages using luminescence dating, Pb210, tree rings etc. Clay mineralogy from XRD data and its relation to weathering pattern. Environmental Magnetism practicals. Multi parametric inferences using proxy climatic parameters.

BOOKS RECOMMENDED:

1. Alastair G. Dawson- Ice Age Earth: Late Quaternary Geology and Climate (Physical Environment)
2. Bell, M. & Walker, M.J.C.1992. Late Quaternary Environmental Change; Physical and human perspective. Longman Scientific and Technical, New York.
3. Geological Society of India: Quaternary of India
4. Krishnan, M. S. : Geology of India
5. Lowe, J.J. & Walker, M. J.C., 1997: Reconstructing Quaternary Environments Longman. ISBN 0-582-100166-2. Pp. 1-16, 148-373.
6. Ruddiman: "Earth's Climate, Past and Future"
7. Wadia: Geology of India and Burma
8. Research articles on each of the above issues available in: Journals related to Quaternary

14. Curriculum- Semester-III (M. Sc. Second Year)

1. Discipline Specific Course (DSC) Major Mandatory

Theory Paper: GEO/MJ/600T: Hydrogeology

Marks: 75

Credits: 3

UNIT I

Ground water, origin, types, importance, occurrence, reservoirs and movement; Vertical distribution of subsurface water; hydrologic properties of rocks: porosity; permeability; specific yield; specific retention, hydraulic conductivity, transmissivity, storage coefficient;

UNIT II

Groundwater quality, estimation of parameters; hydrographs; hydrostratigraphic units; Darcy's Law; Groundwater isotropy and anisotropy.

UNIT III

Well inventory and types of well. Well hydraulics: confined, unconfined, steady, unsteady and radial flow; water level fluctuations; causative factors and their measurements; evaluation of aquifer parameters

UNIT IV

Problem of over exploitation of groundwater; groundwater legislation; salt water intrusion in coastal Aquifers and remedial measures. methods of pumping test and analysis of test data;

UNIT V

Surface and sub-surface geophysical and geological methods of groundwater exploration; radioisotopes in hydrogeological studies, concept of watershed management,

**Practical paper: GEO/MJ/603P
based on GEO/MJ/600T- Hydrogeology**

Marks: 25**Credits: 01**

Hydrogeological properties of rocks; Well Inventory ; Analysis of hydrographs; geophysical and geological methods of ground water exploration; pumping test; time draw down and time recovery tests and evaluation of aquifer parameters using Darcy's law; electric resistivity sounding for delineation of fresh and saline aquifers.

BOOKS RECOMMENDED:

1. Todd, D.K. (1980): Groundwater Hydrology
2. Davies, S.N and De Wiest, R.J.M (1966): Hydrogeology
3. Freeze, R.A. and Cherry, J.A. (1971): Groundwater
4. Fetter, C.W. (1990): Applied Hydrology
5. Raghunath, N.M. (1982): Groundwater
6. Karanth, K.R. (1987): Groundwater assessment, Development and Management
7. Alley, W.M. (1983): Regional groundwater quality
8. Subramaniam, V. (2000) :Water

Theory Paper: GEO/MJ/601T: Geophysical Exploration

Marks: 75**Credits: 3****UNIT I**

Variation of gravity over the surface of the earth; principles of gravimeters; gravity field surveys; various types of corrections applied to gravity data; preparation of gravity anomaly maps and their interpretation in terms of shape, size and depth.

UNIT II

Geomagnetic field of the earth; magnetic properties of rocks; working principles of magnetometers;

UNIT III

Field surveys and data reductions; quantitative interpretation; magnetic anomalies due to single pole, dipole; introduction to aeromagnetic surveys.

UNIT IV

Resistivity methods; basic principles; various types of electrode configurations; field procedure profiling and sounding.

UNIT V

Seismic methods; fundamental principles of wave propagation; refraction and refraction surveys; concept of seismic channels and multi- channel recoding of seismic data; End- on and split spread shooting techniques; interpretation of seismic data.

**Practical Paper GEO/MJ/604
based on GEO/MJ/601T -Geophysical Exploration**

Marks: 25**Credits: 01**

Interpretation of geophysical logs for geological purpose; application of geophysical data in mineral Exploration- gravity data, magnetic data, electrical data; utility of seismic reflection data in recognition of subsurface structures; interpretation of seismic data.

BOOKS RECOMMENDED

1. Sharma, P.V. (1986) : Geophysical Methods in Geology
2. Dobrin, M.B. (1976) : Introduction to Geophysical Prospecting
3. Paransis, D.S. (1975) : Principles of Applied Geophysics
4. Stanislave, M. (1984) : Introduction to Applied Geophysics
5. Rao, M.B.R.: (1975): Outlines of Geophysical Prospecting Manual for Geologists
6. Bleil, D.F., (1953) Induced polarization: A method of geophysical prospecting, Geophysics, 18: 636-661p

7. Haldar, S. K. (2018), Mineral Exploration Principles and Applications, Elsevier Publications, 374p.
8. Gandhi, S.M and Sarkar, B.C. (2016) Essentials of Mineral Exploration and Evaluation, 1st edition, Elsevier Cambridge, 410p
9. Charles J., Whatley Michael K.G. and Evans K.M. (2006) Introduction to mineral exploration, Blackwell publishing, 499p.
10. Marjoribanks Roger (2010) Geological Methods in Mineral Exploration and Mining, Springer Publications, 2nd edition, 243p.
11. <https://egyankosh.ac.in/bitstream/123456789/78249/1/Unit-14.pdf>

Theory Paper: GEO/MJ/602T: Fuel Geology

Marks: 75

Credits: 03

UNIT I

Petroleum- its composition and different fractions; origin, nature and migration (primary and secondary) of oil and gas; transformation of organic matter into kerogene; surface and subsurface occurrence of petroleum and gas.

UNIT II

Characteristics of reservoir rocks and traps (structural, stratigraphic and correlation); oil-bearing basins of India;

UNIT III

Coal- Definition and origin of kerogen and coal; rank, grade and type of coal; Indian and International classifications of coal; macroscopic ingredients and microscopic constituents; concept of maceral and microlitho types.

UNIT IV

Chemical characterization: proximate and ultimate analysis; preparation of coal for industrial purposes: coal carbonization (coke manufacture) coal gasification and coal hydrogenation. Coal bed – methane: a new energy resource.

UNIT V

Atomic fuel- Mode of occurrence and methods of prospecting and productive geological horizons in India; nuclear power stations of the country and future prospects; mud engineering, drilling fluid, gas sampling,

Practical Paper GEO/MJ/605P: based on GEO/MJ/602T Fuel Geology

Marks: 25

Credits: 01

Megascopic characterization of banded coals; proximate analysis of coals; completion of outcrops in the given maps and calculation of coal reserves; study of geological maps and sections of important oilfields of India; Calculation of oil reserves.

BOOKS RECOMMENDED

1. Taylour, G.H., Teichmuiler, M., Davis, A., Diessel, C.F.K. and others: Organic Petrology
2. Selley, R.C.: Elements of Petroleum Geology
3. Chandra, D., Singh, R.M and Singh, M.P.: Textbook of Coal
4. Singh, M.P.: Coal and Organic Petrology
5. Stach, E, Macknowsty, M.T.H; Taylor, H.H and others: Stach's Textbook of Coal Petrology
6. Durrance, E.M.: Radioactivity in Geology: Principles and Applications

GEO/MJ/606: Geological Survey and Sampling Techniques (Practical Paper)

Marks: 50

Credits: 02

Maps and their types; Toposheets, aerial photographs, satellite imagery; Use of toposheets for selection of sampling sites; interpretation of litho-log, Core-log; interpretation of geomorphological, geological, structural maps, hydrogeochemical maps. Sampling techniques for collection of -water, soil, rocks, and fossils. Thin section preparation, water quality analysis, sieve analysis, Techniques of separation of microfossils from matrix and picking of microfossils.

References: Mining Geology Sampling Methods: Channel, Chips, Core :

<https://www.911metallurgist.com/blog/mining-geology-sampling-methods-channel-chip-core>

Sampling and estimation of ore deposits- <https://dggs.alaska.gov/webpubs/usbm/b/text/b356.pdf>

2. Discipline Specific Elective (DSE)

(Choose any one from pool of courses A/B/C with its respective practical)

Theory paper- GEO/DSE/607AT: Statistical Geology

Marks: 75

Credits: 03

UNIT I

Statistical methods; mean; median and mode; standard deviation; skewness and kurtosis and their interrelationship; frequency distribution; coefficient of correlation and regression

UNIT II

Nature of geological data; scales of measurement; sample population; population distribution and population density function and their properties

UNIT III

Distribution of sample variance and chi square distribution; probability; testing normal distribution; students 't' test, 'f' test; confidence interval, analysis

UNIT IV

Concepts and types of statistical models in geology; calculation of variance - covariance, simple linear models; clusteranalysis.

UNIT IV

Graphical representation of statistical data; tools types and interpretations- scatter diagrams; histogram; pie chart; bar diagram and linear diagram.

Practical Paper GEO/DSE/608AP based on GEO/DSE/607AT STATISTICAL GEOLOGY

Marks: 25

Credits: 01

Interpretation of histograms, cumulative curves, scatter diagrams; pie diagram; mean, median and mode; standard deviation; skewness and kurtosis and their interrelationship.

BOOKS RECOMMENDED

1. J.C.Davis: - Statistics and data analysis in Geology
2. B.L.Raktoe and J.J. Hubert: - Basic applied Statistics
3. P.Mukhopadhy: - Mathematical Statistics
4. H.E. Klugh: - Statistics- the essential for research
5. E.B. Mode: - Elements of statistics

OR

Theory paper- GEO/DSE/607BT: Watershed Development and Management

Marks: 75

Credits: 03

UNIT I

Concepts of Watershed; Interpretation of Toposheet; Geomorphology of watershed area; Groundwater Acts and Legislation.

UNIT II

Groundwater provinces of India, groundwater quality map of India; water table contour maps; Groundwater audit and budgeting;

UNIT III

Hydrogeomorphic mapping using various Remote Sensing and GIS techniques. Renewable and non- renewable groundwater resources.

UNIT IV

Methods of artificial groundwater recharge; Methods of rainwater harvesting; Water management in rural and urban areas.

UNIT V

Land use and land cover; Groundwater hydrogeomorphic units; Ground water management technical and social aspects.

Practical paper- GEO/DSE/608BP:

Based on GEO/DSE/607BT: Watershed Development and Management

Marks: 25

Credits: 01

Preparation of contour map, Preparation of hydrograph, Water budget, Study of toposheet, Interpretation of hydrogeomorpho units. Well Inventory, Preparation of thematic maps. Aerial Photographs and satellite imagery.

BOOKS RECOMMENDED:

1. Todd, D.K. (1980): Groundwater Hydrology
2. Raghunath, N.M. (1982): Groundwater
3. Karanth, K.R. (1987): Groundwater assessment, Development and Management
4. Pandey S.N. (1987): Principles and Application of Photogeology
5. Gupta (1990): Remote Sensing Geology
6. Thornbury: Principles in Geomorphology
7. Anjy Reddy : Text Book of Remote Sensing and Geographical Information.
8. GSDA Reference Book

OR

Theory paper: GEO/DSE/607CT: Marine Geology and Climatology

Marks: 75

Credits: 03

UNIT I

History of marine geology, scope and applications of marine geological investigations; introduction to oceanic petrology and micropaleontology, Coastal Zone Morphology (Estuaries, deltas, bays, raised beaches, features of wave erosion and deposition, tombolos, mud banks)

UNIT II

Ocean floor topography- continental margins, continental shelf, slope, rise and ocean floor. Deep sea Morphology (Continental shelf, Continental slope, abyssal plains, sea mounts, guyots, fracture pattern.

UNIT III

Evolution of oceans, Sea floor spreading, Mid-oceanic ridges, submarine volcanism, Tsunami-causes & effects.

UNIT IV

Atmospheric layers, insolation, Long wave & short wave radiation, temperature variation, precipitation, humidity, air masses, atmospheric pressure, winds, atmospheric instability.

UNIT V

Climate Classification, Koppen's and Trewartha climate classification, Cloud formation, types & classification.

Practical paper: GEO/DSE/608CP:

Based on GEO/DSE/607CT: Marine Geology and Climatology

Marks: 25

Credits: 01

Drawing and interpretation oceanic profile, atmosphere layer map, marine microfossils and rocks.
Climatic zones of India.

BOOKS RECOMMENDED:

1. King, C.A.M., (1975). Introduction to marine Geology and Geomorphology. Edward Arnold, London.
2. Radhakrishnan, V., (1996). General Geology V.V.P. Publishers, Tuticorin.
3. Seabold, E. and Berger, W.H., (1982). The Sea Floor, Springer Verlag.
4. Kuenen, Ph.H., 1950. Marine Geology. John Wiley and Sons.
5. Shepard, F.P., (1978). Geological Oceanography, Heinmann, London.
6. Harper and Row. Kurekian, K.K., 1990. Ocean, Prentice Hall. New Jersey.
7. Svedrup, J.F., (1969). The Ocean, A Scientific American book, W.H. Freeman and company, San Francisco.
8. Kennett, J.P. (1982). Marine Geology. Prentice Hall. New Jersey.
9. Weisberg, C.P. (1979). Oceanography. McGraw Hill. New York

3. Research Project-1 - GEO/RM/609:

As decided and approved by the Departmental Committee

15. Semester-IV(M.Sc. II Year)

1. Discipline Specific Course (DSC) Major Mandatory

Theory Paper GEO/MJ/650T: Environmental Geology

Marks: 75

Credits: 03

UNIT I

Introduction, environmental dilemmas, fundamental concepts of environmental geology. Environmental protection – legislative measures in India

UNIT II

Chemistry of greenhouse gases, emission of CO₂, consequences of greenhouse gases, control and remedial measures, global warming a serious threat, global warming caused by CO₂ increase in present atmosphere due to indiscrete exploitation of fossil fuels

UNIT III

The concept of earth system cycles in earth system- The energy cycle (energy inputs, solar radiations, geothermal energy, tidal –energy). The rock cycles (heat transfer in earth, plate tectonics and earth's external structure).

UNIT IV

Environmental impacts of mining, surface blasting etc. Impact assessment of mining; dumping of ores; mine waste and fly ash; Soil profiles, texture, structure and soil quality degradation.

UNIT V

Impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; organic and inorganic contamination of groundwater and its remedial measures; water logging problems.

Practical Paper GEO/MJ/653P

based on GEO/MJ/650T: Environmental Geology

Marks: 25

Credits: 01

Study of seismic and flood prone in India; hydrochemistry analysis surface water and subsurface water; classification of groundwater for use in drinking, irrigation and industrial purposes; presentation of chemical analysis; data and plotting; chemical classification diagram; evaluation of environmental impact of air pollution and groundwater pollution; deforestation; landslides.

BOOKS RECOMMENDED

1. Keller, E.A.: Environmental Geology
2. Buyant, E.: Natural Hazards
3. Valdiya, K.S.: Environmental Geology- Indian Context
4. Patwardhan, A.M.: The Dynamic Earth System
5. Bell, F.G.: Geological Hazards
6. Smith, K.: Environmental Hazards
7. Subramaniam, V.: Textbook in Environmental Hazards
8. Tank, R.W.: Focus on Environmental Hazards
9. Strahler and Strahler: Environmental Geology
10. Truk and Truk: Environmental Geology

Theory Paper GEO/MJ/ 651T Engineering Geology

Marks: 75

Credits: 03

UNIT I

Role of engineering geology in civil construction; engineering properties of rocks and soils; rock discontinuities; building stones; metal and concrete aggregates as construction material; use of aerial photography, groundwater investigation; subsurface exploration

UNIT II

Geological consideration for evaluation of dams and reservoirs sites; classification of dams; dam foundation problems; reservoir problems

UNIT III

Geotechnical evaluation of tunnels; classification of tunnels; methods of tunnelling and tunnel design; support in tunnelling; roads, bridges and bridge foundation; airfields, highways.

UNIT IV

Mass movements; landslides; stability of slopes; causes of slides; creep movement; earth flow and subsidence - precautionary measures and mitigations of hazards.

UNIT V

Earthquake and seismicity; seismic zones of India; aseismic design of building; engineering problems related to precautionary measures and mitigations of hazards; beach engineering.

Practical Paper GEO/MJ/654P based on GEO/MJ/ 651T Engineering Geology

Marks: 25

Credits: 01

Suitable dam sites, selection for sites of tunnels; seismic zones in India; compressional strength, tensile strength of rock and building materials; hardness test; roughness test; magnetic, seismic and electrical resistivity methods of exploration as applied to engineering investigations; interpretation of drilling data for engineering construction.

BOOKS RECOMMENDED

1. Krynine and Judd: - Principles of Engineering Geology
2. Richeny, J.E.: - Elements of Engineering Geology
3. Lagget: - Geology and Engineering
4. Trefethen, Joseph- Geology of Engineers
5. Gupta, R: -Textbook of Engineering Geology

Theory Paper GEO/MJ/652T- Mining Geology

Marks: 75

Credits: 03

UNIT I

Intersecting loci and ring targets; guides to ore localization. Methods of breaking rocks; Explosives used in mining.

UNIT II

Surface mining methods: mechanical and aqueous extraction.

UNIT III

Subsidence and the support of mine excavation; timber as support and its treatment; drilling blastholes; shaft sinking; mine drainage; ventilation.

UNIT IV

Underground mining methods: Room and pillar, vein mining, cut and fill stoping; Shrinkage stoping, Longwall mining; Caving Methods: top-slicing, sub- level caving and block caving; ocean bottom mining.

UNIT V

Theory and methods of sampling; Factors in evaluating a mineral deposit; Cost of mining; future costs and profits; life of mine; present value of mine and its determination by compound interest and Hoskolds' formula methods; amortisation; valuation of prospects: developed mines and working mines; valuation report.

Practical Paper GEO/MJ/655P based on GEO/MJ/652T Mining Geology

Marks: 25

Credits: 90

Determination and evaluation of ores in mines; different sampling calculations; recoverable values; cost of mining; future cost and profits; life of mine; determination of present value of mines; cross section of mines with the help of available data.

BOOKS RECOMMENDED

1. Young, G.J.: Elements of Mining
2. Lewis, R.A. and Clark, G.A.: Elements of Mining
3. Arogyaswami : Mining Geology
4. Mckinstry, H.E.: Mining Geology
5. Sheryanthov, L.: Mining of Mineral deposits

GEO/MJ/656: Geological Fieldwork

As decided by the departmental committee

2. Discipline Specific Elective (DSE)-

(Choose any one from pool of courses A/B/C with its respective practical)

Theory Paper: GEO/DSE/657AT: Groundwater Exploration

Marks: 75

Credits: 03

UNIT I

Surface methods for groundwater exploration- geomorphological and geological, remote sensing and GIS, geobotanical, Eustatic methods, dowsing methods, water witching, etc.

UNIT II

Gravity method: Nature of gravity and its variation. Accuracy and precision of measurements. Gravimeters. Field procedures. Corrections. Free-air & Bouger anomalies. Interpretation of anomalies.

UNIT III

Seismic method: Seismic waves and their speeds in rocks. Critical refraction. Instruments and field procedures for seismic refraction method. Interpretation of data. Seismic reflection methods for groundwater exploration. Equipment for seismic reflection.

UNIT IV

Electrical methods: Introduction to S.P method and its use. Resistivity, true and apparent D.C. resistivity, true and apparent D.C. resistivity equipment,

UNIT V

Electrode arrangement methods, field procedure and use for ground water exploration.

**Practical paper: GEO/DSE/658AP
based on GEO/DSE/657AT: Groundwater Exploration**

Marks: 25

Credits: 01

Resistivity meter, Collection of field data, plotting of Resistivity data and its interpretation for groundwater exploration. Toposheets, geological maps, aerial photos and Satellite imagery and its interpretation in view of groundwater exploration. Study of rocks for understanding aquifers characteristics.

BOOKS RECOMMENDED

1. Phillip Keary, Michel Brooks, Ian Hill (2002): An Introduction to Geophysical Exploration
2. Venkateswaran.S (2010) Groundwater exploration techniques, TNBH publishers, Chennai, Tamilnadu. ISBN 978-81-9234-992-3.
3. Sharma, P.V. (1986) : Geophysical Methods in Geology
4. Dobrin, M.B. (1976) : Introduction to Geophysical Prospecting
5. Rao, M.B.R.: (1975): Outlines of Geophysical Prospecting Manual for Geologists

OR

Theory Paper GEO/DSE/657BT: Disaster Management

Marks: 75

Credits: 03

Unit I

Natural Hazard – definition -Earth's processes: catastrophic geological hazards: study of floods, tsunamis, Landslides, Earthquakes, Volcanism and avalanches – with a view to assess the magnitude of the problem, prediction and perception of the hazards. Laws and regulations towards hazard management.

Unit II

Earthquakes-Definition –focus -epicenter-seismic waves-intensity and magnitude- Richter scales; Tsunami Seismograph- seismogram-seismicity in Indian region - Seismic gaps - mitigation measures and management. Preparation of seismic hazard map. Plate boundary related earthquake.

Unit III

Volcanoes-Definition-structure - types –Global distribution - mitigation measures and management. Avalanche – Definition – types – mitigation. Flood- Definition - causes vulnerable zones in India-Mitigation measures and management. Coastal erosion – its causes-mitigation measures and management.

Unit IV

Landslides- types -slow flowage, rapid flowage, sliding and subsidence – causes and mechanism - mitigation measures and management; Cyclone- Definition -causes - mitigation measures and management.

Unit V

Mass movement – factor influencing slope stability – types of mass movement – hazards of mass movement – strategies for their reduction and the role of geology; Soil erosion –soil classification – factor influencing soil erosion – hazards of soil erosion; Drought – types, mitigation measures.

Practical Paper GEO/DSE/658BP: Disaster Management based on GEO/DSE/657BT: Disaster Management

Marks: 25

Credits: 01

Study of flood, landslides, earthquake, tsunami, drought, cyclone, volcanic eruption, avalanches, and mass movement prone sites of India.

BOOKS RECOMMENDED:

1. K. S. Valdiya (2004). Geology, environment, Society. Universities Press (India) Private Limited, Hyderabad, India
2. K. S. Valdiya (2004). Coping with natural hazards: Indian context. Orient Longman Private Limited, Hyderabad, India.
3. Parbin Singh (2003). Engineering and General Geology. S.K. Kataria and sons Delhi India
4. V. Radhakrishnan (1996). General Geology. V.V.P. Publishers, Tuticorin, India.
5. Lundgren (1986). Environment Geology, Prentice Hall Publishers, New Jersey.
6. Ramkumar, M., (2009) Geological hazards: Causes, Consequences and methods of Containment. New India Publishers, New Delhi.
7. Holmes. A. (1972). Principles of Physical Geology. The English Language Book Society and Nelson

OR

Theory Paper GEO/DSE/657CT -Drilling and Logging

Marks: 75

Credits: 03

UNIT I

Geological aspects of drilling-Types of drilling; drill rods and bits.

UNIT II

Drilling methods; planning and selection of sites, angle and direction of bore-holes; Directional drilling; drilling fluids; water well drilling methods.

UNIT III

Drilling and Blasting patterns; Types of drilling in surface and underground mining; Standard Penetration Test (SPT); Introduction of Deep Sea Drilling Project (DSDP) and JOIDES, ODP, IODP, JGOFS.

UNIT IV

Concept of logging; Logging procedures-core logging and its interpretation; brief outline of various well-logging techniques- (Open and Cased log, Borehole Environment (Pressure and Temperature), Borehole diameter; Caliper log ; Electrical logs including Laterolog; Neutron log, Sonic log; density logging; cross plotting; Principles of radioactive (gamma and spectral gamma) and geothermal logging); principles of electrical logging and its application in- petroleum, groundwater and mineral exploration.

UNIT V

Wireline Logging; Mud engineering, mud logging, drilling fluids, gas sampling; core / sludge recovery;

