॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) M. Sc. II year Biotechnology (Affiliated College)
2) M. Sc. II year Biotechnology (Campus)
3) M. Sc. II year Bioinformatics (Sub Campus Latur)
4) M. Sc. II year Bioinformatics (Affiliated College)
5) M. Sc. II year Clinical Research (Affiliated College)
6) M. Sc. II year Botany (Campus)
7) M. Sc. II year Herbal Medicine
8) M. Sc. II year Boany (Affiliated College)
9) M. Sc. II year Geology (Campus)
10) M. Sc. II year Dairy Science
11) M. Sc. II year Electronics
12) M. Sc. II year Environmental Science
13) M. Sc. II year Environmental Science (Campus)
14) M. Sc. II year Geography (Campus)
15) M. Sc. II year Applied Mathematics
16) M. Sc. II year Mathematics
17) M. Sc. II year Mathematics (Campus)
18) M. Sc. II year Microbiology
19) M. Sc. II year Microbiology (Campus)
20) M. Sc. II year Statistics
21) M. Sc. II year Statistics (Campus)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/१०९
दिनांक १२.०६.२०२४

डॉ. सरिता लोसरवार
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH

MARATHWADA UNIVERSITY, NANDED - 431 606

(**Structure and Syllabus of Two Years Multidisciplinary Degree Program with Multiple Entry and Exit Option**)

TWO YEAR MASTERS PROGRAMME IN SCIENCE

Subject **Geology**

Under the Faculty of
Science and Technology

Effective from Academic year 2023 – 2024
(As per NEP-2020)

From Desk of Chairman, Board of Studies of the Subject Geology

Preamble:

Syllabus of M.Sc. Geology program offered by the School of Earth Sciences has been prepared as per the Credit Framework guidelines of National Education Policy (NEP) 2020 and considering the syllabi of the UPSC Geologists examination, MPSC examination, CSIR-NET examination and the requirements of the industry. The M.Sc. program in Geology is imparted to the students for two academic years consisting of four semesters. Candidates will be examined and evaluated on grade basis at the end of each semester in different theory and practical papers as per the credits offered by each course.

The M.Sc. Geology program consists of Core Courses, Electives Courses, Research Methodology, Publication Ethics and On Job Training. This two year program is of total 88 credits, with 22 credits for each semester. The program includes Core and Elective Courses. Students can choose one Elective Course per semester from the list of Elective Courses provided. Students are also encouraged to select Open Elective courses from National Educational Platforms such as MOOCS/NPTL/SWAYAM. If a student wishes, he/she can take a few extra courses, which will be considered as add-on credits.

In addition to class-room teaching and laboratory, the M.Sc. Geology program offers geological field training to the students. After completion of field training, students have to submit a filed report to the School. Intensive On Job Training /Internships in the nationally reputed institutes shall also be provided to the M.Sc. Geology students. The semester breaks can also be utilized for the geological field training and internships.

Students will be assessed through Continuous Assessment (CA) and End Semester Assessment (ESA). Mode of Continuous Assessment (CA) will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting Two Tests (Test I on 40% curriculum) and Test II (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his CA score. The End Semester Assessment (ESA) (80% of the Maximum Marks) will be based on paper-pen pattern and laboratory experiments/calculations.

Every M.Sc. Geology student has to mandatorily submit dissertation thesis. The Research Project/Dissertation is of 10 Credits, 4 Credits are in third semester and 6 credits are in fourth semester. The 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. The thesis should be based on sound methodology and well defined objectives. Through dissertation work the student should be well-versed with the literature on the chosen topic, independently define a scientific problem, carry out focused study on a research topic, analyze and interpret large data sets, independently write thesis / project proposal and present and defend the dissertation work. The Dissertation must be submitted by the end of fourth Semester with a Seminar presentation in the presence of faculty members, students and external examiners for the purpose of evaluation. The School of Earth Sciences strongly encourages the M.Sc. Geology students to publish their dissertation work in SCI journals.

Prof. Dr. Dipak Baburao Panaskar
Chairman, Board of Studies of the Geology,
Swami Ramanand Teerth Marathwada University, Nanded

Details of the Board of Studies Members in Geology under the faculty of Science & Technology of S.R.T.M. University, Nanded

Sr No	*Name of the Member*	*Designation*	*Address*	*Contact No.*
1	*Dr. Dipak Baburao Panaskar*	*Senior Professor*	*School of Earth Sciences, S. R. T. M. University, Nanded*	*9403227259*
2	*Dr. Hari Shankarrao Patode,*	*Associate Professor*	*School of Earth Sciences, S. R. T. M. University, Nanded*	**9850209045**
3	*Dr. Shaikh MD Babar,*	*Professor*	**DSM 's College of Arts, Commerce and Science College, Parbhani**	**9890184699**
4	*Dr. Bhagwan Balasaheb Ghute,*	*Assistant Professor*	**Toshniwal Arts, Commerce & Science College, Sengaon, Tq. Sengaon, Dist Hingoli.**	**9130006333**
5	*Dr. Udaykumar Laxmikant Sahu,*	*Assistant Professor*	**Toshniwal Arts, Commerce & Science College, Sengaon, Tq. Sengaon, Dist Hingoli.**	**9860406757**
6	*Prof. D. C. Meshram*	*Professor*	**Department of Geology, S. P. Pune University, Pune**	**8275697166**
7	*Dr. A. N. Dongre*	*Associate Professor*	**Department of Geology, S. P. Pune University, Pune**	**9922410132**
8	*Dr. Sukanta Roy*	*Principal Scientist (F) & Project Director*	**BGRL, Ministry of Earth Sciences, Karad**	**9490469980**
9	*Prof. A. R. Kulkarni*	*Professor*	**SIBER, Kolhapur**	**7588470146**

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Geology

Year & Level 1	Sem. 2	Major Subject (DSC) 3	Major Subject (DSE) 4	RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	SGLGCC2401 Mineralogy (4 Cr) Theory SGLGCC2402 Structural Geology and Geotectonics (4 Cr) Theory SGLGCC2403 Palaeontology and Stratigraphy (4 Cr) Theory	SGLGEC2401 Geochemistry (3 Cr) Theory SGLGEP2401 Geochemistry (1 Cr) Practical	**SGLGRM2401** *Research Methodology* **(3 Cr)**	--		SGLGCP2401 Mineralogy (1 Cr) Practical SGLGCP2402 Structural Geology and Geotectonics (1 Cr) Practical SGLGCP2403 Palaeontology and Stratigraphy (1 Cr) Practical	**22**	**44**
	2	SGLGCC2451 Igneous Petrology and Sedimentary Petrology (4 Cr) Theory SGLGCC2452 Thermodynamics and Metamorphic Petrology (4 Cr) Theory SGLGCC2453 Environmental Geology (4 Cr) Theory	SGLGEC2451 Computer Applications in Geology (3 Cr) Theory SGLGEP2451 Computer Applications in Geology (1 Cr) Practical **OR** SGLGEC2452 Geomorphology and Morphotectonics (3 Cr) Theory SGLGEP2452 Geomorphology and	---	**SGLGOJ2451 (3 Cr)**	--	SGLGCP2451 Igneous Petrology and Sedimentary Petrology (1Cr) Practical SGLGCP2452 Thermodynamics and Metamorphic Petrology (1 Cr) Practical SGLGCP2453 Environmental Geology	**22**	

			Morphotectonics (1 Cr) Practical				(1 Cr) Practical		
Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	**3**	SGLGCC2501 Economic Geology and Geology of India Mineral Deposits (4 Cr) Theory SGLGCC2502 Hydrogeology (4 Cr) Theory SGLGCC503 Remote Sensing and Geographical Information System (4 Cr) Theory	SGLGEC2501 Principles of Geophysics (2 Cr) Theory SGLGEP2501 Principles of Geophysics (1 Cr) Practical **OR** SGLGEC2502 Engineering Geology (2 Cr) Theory SGLGEP2502 Engineering Geology (1 Cr) Practical (***From same Department / School)***	--		**SGLGRP2501 (4Cr)** Research Project	SGLGCP2501 Economic Geology and Geology of India Mineral Deposits (1 Cr) Practical SGLGCP2502 Hydrogeology (1 Cr) Practical SGLGCP2503 Remote Sensing and Geographical Information System (1 Cr) Practical	**22**	**44**
	4	SGLGCC2551 Coal and Petroleum Geology (4 Cr) Theory SGLGCC2552 Geoexploration, Mining Geology and Mineral Economics (4 Cr) Theory	SGLGEC2551 Disaster Management (3 Cr) Theory SGLGEP2551 Disaster Management (1 Cr) Practical (***From same Department / School)***	**SGLGPE2551** Publication Ethics (2 Cr)		**SGLGRP2551 (6 Cr)** Research Project	SGLGCP2551 Coal and Petroleum Geology (1 Cr) Practical SGLGCP2552 Geoexploration, Mining Geology and Mineral Economics (1 Cr) Practical	**22**	
Total Credits		**44**	**15**	**05**	**03**	**10**	**11**	**88**	

M. Sc. First Year Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SGLGCC2401**	Mineralogy	04	--	**04**	04	--
	SGLGCC2402	Structural Geology and Geotectonics	04	--	**04**	04	--
	SGLGCC2403	Palaeontology and Stratigraphy	04	--	**04**	04	--
Elective (DSE)	**SGLGEC2401**	Geochemistry	03	--	**03**	03	--
Research Methodology	**SGLGRM2401**	Research Methodology	03	--	**03**	03	
DSC Practical	**SGLGCP2401**	Mineralogy	--	01	**01**	--	02
	SGLGCP2402	Structural Geology and Geotectonics	--	01	**01**	--	02
	SGLGCP2403	Palaeontology and Stratigraphy	--	01	**01**	--	02
DSE Practical	**SGLGEP2402**	Geochemistry	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester I *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits of individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SGLGCC2401**	Mineralogy	20	20	20	80	--	--	100
	SGLGCC2402	Structural Geology and Geotectonics	20	20	20	80	--	--	100
	SGLGCC2403	Palaeontology and Stratigraphy	20	20	20	80	--	--	100
Elective (DSE)	**SGLGEC2401**	Geochemistry	15	15	15	60	--	--	75
Research Methodology	**SGLGRM2401**	Research Methodology	15	15	15	60	--	--	75
DSC Practical	**SGLGCP2401**	Mineralogy	--	--	--	--	05	20	25
	SGLGCP2402	Structural Geology and Geotectonics	--	--	--	--	05	20	25
	SGLGCP2403	Palaeontology and Stratigraphy	--	--	--	--	05	20	25
DSE Practical	**SGLGEP2402**	Geochemistry	--	--	--	--	05	20	25

M. Sc. First Year Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SGLGCC2451**	Igneous Petrology and Sedimentary Petrology	04	--	**04**	04	--
	SGLGCC2452	Thermodynamics and Metamorphic Petrology	04	--	**04**	04	--
	SGLGCC2453	Environmental Geology	04	--	**04**	04	--
Elective (DSE)	**SGLGEC2451 OR SGLGEC2453**	Computer Applications in Geology OR Geomorphology and Morphotectonics	03	--	**03**	03	--
On Job Training	**SGLGOJ2451**	ON Job Training	--	03	**03**	--	03
DSC Practical	**SGLGCP2451**	Igneous Petrology and Sedimentary Petrology	--	01	**01**	--	02
	SGLGCP2452	Thermodynamics and Metamorphic Petrology	--	01	**01**	--	02
	SGLGCP2453	Environmental Geology	--	01	**01**	--	02
DSE Practical	**SGLGEP2452 OR SGLGEP2454**	Computer Applications in Geology OR Geomorphology and Morphotectonics	--	01	**01**	--	02
Total Credits			**15**	**07**	**22**	**15**	**11**

M. Sc. First Year Semester II *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits of individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SGLGCC2451**	Igneous Petrology and Sedimentary Petrology	20	20	20	80	--	--	100
	SGLGCC2452	Thermodynamics and Metamorphic Petrology	20	20	20	80	--	--	100
	SGLGCC2453	Environmental Geology	20	20	20	80	--	--	100
Elective (DSE)	**SGLGEC2451 OR SGLGEC2453**	Computer Applications in Geology OR Geomorphology and Morphotectonics	15	15	15	60	--	--	75
On Job Training	**SGLGOJ2451**	ON Job Training	--	--	--	--	15	60	75
DSC Practical	**SGLGCP2451**	Igneous Petrology and Sedimentary Petrology	--	--	--	--	05	20	25
	SGLGCP2452	Thermodynamics and Metamorphic Petrology	--	--	--	--	05	20	25
	SGLGCP2453	Environmental Geology	--	--	--	--	05	20	25
DSE Practical	**SGLGEP2452 OR SGLGEP2454**	Computer Applications in Geology OR Geomorphology and Morphotectonics	--	--	--	--	05	20	25

M. Sc. First Year Semester III *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SGLGCC2501**	Economic Geology and Geology of India Mineral Deposits	04	--	**04**	04	--
	SGLGCC2502	Hydrogeology	04	--	**04**	04	--
	SGLGCC2503	Remote Sensing and Geographical Information System	04	--	**04**	04	--
Elective (DSE)	**SGLGEC2501 OR SGLGEC2502**	Principles of Geophysics OR Engineering Geology	02	--	**02**	02	--
Research Project	**SGLGRP2501**	Research Project	--	04	**04**	--	04
DSC Practical	**SGLGCP2501**	Economic Geology and Geology of India Mineral Deposits	--	01	**01**	--	01
	SGLGCP2502	Hydrogeology	--	01	**01**	--	01
	SGLGCP2503	Remote Sensing and Geographical Information System	--	01	**01**	--	01
DSE Practical	**SGLGEP2501 OR SGLGEP2502**	Principles of Geophysics OR Engineering Geology	--	01	**01**	--	01
Total Credits			**14**	**08**	**22**	**14**	**08**

M. Sc. First Year Semester III *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits of individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SGLGCC2501**	Economic Geology and Geology of India Mineral Deposits	20	20	20	80	--	--	100
	SGLGCC2502	Hydrogeology	20	20	20	80	--	--	100
	SGLGCC2503	Remote Sensing and Geographical Information System	20	20	20	80	--	--	100
Elective (DSE)	**SGLGEC2501 OR SGLGEC2502**	Principles of Geophysics OR Engineering Geology	15	15	15	60	--	--	75
Research Project	**SGLGRP2401**	Research Project	--	--	--		15	60	75
DSC Practical	**SGLGCP2501**	Economic Geology and Geology of India Mineral Deposits	--	--	--	--	05	20	25
	SGLGCP2502	Hydrogeology	--	--	--	--	05	20	25
	SGLGCP2503	Remote Sensing and Geographical Information System	--	--	--	--	05	20	25
DSE Practical	**SGLGEP2501 OR SGLGEP2502**	Principles of Geophysics OR Engineering Geology	--	--	--	--	05	20	25

M. Sc. First Year Semester IV *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SGLGCC2551**	Coal and Petroleum Geology	04	--	**04**	04	--
	SGLGCC2552	Geoexploration, Mining Geology and Mineral Economics	04	--	**04**	04	--
Elective (DSE)	**SGLGEC2551**	Disaster Management	03	--	**03**	03	--
Publication Ethics	**SGLGPE2551**	Publication Ethics	02	--	**02**	02	--
Research Project	**SGLGRP2551**	Research Project	--	06	**06**	--	06
DSC Practical	**SGLGCP2551**	Coal and Petroleum Geology	--	01	**01**	--	02
	SGLGCP2552	Geoexploration, Mining Geology and Mineral Economics	--	01	**01**	--	02
DSE Practical	**SGLGEP2551**	Disaster Management	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Semester IV *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits of individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SGLGCC2551**	Coal and Petroleum Geology	20	20	20	80	--	--	100
	SGLGCC2552	Geoexploration, Mining Geology and Mineral Economics	20	20	20	80	--	--	100
Elective (DSE)	**SGLGEC2551**	Disaster Management	15	15	15	60	--	--	75
Publication Ethics	**SGLGPE2551**	Publication Ethics	10	10	10	40	--	--	50
Research Project	**SGLGRP2551**	Research Project					50	100	150
DSC Practical	**SGLGCP2551**	Coal and Petroleum Geology	--	--	--	--	05	20	25
	SGLGCP2552	Geoexploration, Mining Geology and Mineral Economics	--	--	--	--	05	20	25
DSE Practical	**SGLGEP2451**	Disaster Management	--	--	--	--	05	20	25

SGLGCC2401: Mineralogy *(4 Cr) (Major 1) Curriculum Details*

Course pre-requisite:

1. Basic (10+2) knowledge of chemistry and physics + good observational skills

Course objectives:

1. Minerals are the fundamental blocks of all Earth's solid material and also that of the inner planets of our Solar system. Mineralogy is essential for the courses in igneous, sedimentary and metamorphic petrology, economic geology and for interpretation of geophysical data.
2. This course in Mineralogy would help the students to understand distribution of minerals in different Earth's spheres, evaluate different processes of mineral formation, why some minerals are restricted to particular physic-chemical environments, identify and characterize the minerals based on their physical, crystal chemical and optical properties.
3. The student will study the basic principles behind the arrangement of atoms to form crystal structures, how these atoms are coordinated and bonded and how this is reflected in the external form, chemical composition, and physical properties of the crystals.
4. The student will study how to identify the most common minerals in hand specimen and, by using optical techniques, learn how to identify the common minerals in thin section.
5. The course introduces the minerals, which are of economic significance. The course also introduces the student to sophisticated instruments used in deciphering mineral structure and chemistry.

Course outcomes:

At the completion of the course students would be able to

1. Explain why different minerals have distinctly different structures.
2. Explain distribution of elements in different structural sites of the minerals.
3. Explain how the properties of chemical elements and their bonds determine the structure and composition of minerals.
4. Demonstrate how the internal structure of minerals affects the external structure and physical properties of minerals
5. Explain the mineralogical concepts of isomorphism, polymorphism, isostructuralism, solid solution and exsolution.
6. Discuss which mineral identification method is appropriate for solving a mineralogical problem (e.g. polarizing microscope, x-ray diffraction, electron microprobe).
7. Recognize and describe the basic properties and chemistry of common rock-forming minerals.

Curriculum Details: *(There shall be FOUR Modules in each course)*

SGLGCC2401: Mineralogy

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction and Scope**	**15**
	1.1	Mineralogy and its scope.	
	1.2	Classification of Minerals.	
	1.3	Processes of Mineral formation.	
2.0		**Physical Properties of Minerals**	**15**
	2.1	Properties under light	
	2.2	Electrical properties.	
	2.3	Magnetic properties.	
	2.4	Radioactive properties.	
3.0		**Chemistry and Structure of Minerals**	**15**
	3.1	Basic properties of Elements, Chemical and Geochemical Classification of Elements.	
	3.2	Solid solution, Exsolution, Pauling's Rules, Goldschmidt's Rules, Principles and use of EPMA & ICP-MS in Mineralogical Studies.	
	3.3	Silicate Structures.	
	3.4	Polymorphism, Pseudomorphism.	
4.0		**Optical Properties of Minerals & Descriptive Mineralogy**	**15**
	4.1	Basic introduction to wave propagation.	
	4.2	Isotropy and Anisotropy of Minerals, Petrological Microscope, Optical indicatrices, Orthoscopic properties, Conoscopic properties.	
	4.3	Silicates, Oxides, Carbonates, Sulphides.	
	4.4	Precious and Semi-precious stones.	
		Total	**60**

SGLGCP2401 Mineralogy (1 Cr) Practical

1. Study of Rock-forming minerals in Hand Specimen.
2. Study of Rock-forming minerals in Thin Section.
3. Conoscopic Observations of minerals.
4. Calculation of Mineral Chemical Formulae

Text Books and Reference Books:

- *****An Introduction to the Rock-Forming Minerals by W.A. Deer, R.A. Howie and J. Zussman (Descriptive Mineralogy)
- *Crystallography by Walter Borchardt-Ott (X-Ray Diffraction and Crystal Chemistry)
- *Manual of Mineralogy by C. Klein and C.S. Hurlbut (Prescribed Text Book)
- *Rutley's Elements of Mineralogy by C.D. Gribble (An Elementary text Book)
- An introduction to Mineralogy for Geologists by Phillips and Phillips (Crystallography, Crystal Chemistry & Silicate Structures)
- Dana's New Mineralogy by Gaines, Skinner, Ford, Mason, Rosenzneig (Descriptive Mineralogy)
- Heavy Minerals in Colour by Mange and Maurer (Good Photographs & brief description of Heavy Minerals)
- Introduction to Mineralogy by William D Nesse
- Mineralogy by Berry Mason and Dietrich (Descriptive Mineralogy)
- Mineralogy by Perkins
- Minerals by G.W. Robinson (Good Photographs of Minerals)
- Optical Mineralogy by Paul F. Kerr
- Optical Mineralogy by P.R.J. Naidu
- Optical Mineralogy by Phillips andGriffen (Optical Mineralogy)
- Principles of Crystal Chemistry by E. Cartmell (Crystal Chemistry)
- Principles of Mineralogy by Blackburn and Denner (X-Ray Crystallography & Descriptive Mineralogy)
- Rock and Minerals by Dougel Dixon (Good Photographs)
- Rock-forming Minerals in Thin Section by H. Pichler and C. Schmitt-Riegraf (Thin Section Photographs)
- Rocks and Minerals by Basil Booth (Good Photographs)
- Rocks and Minerals by Chris Pellant (Good Photographs)
- The Illustrated Encyclopedia of Minerals and Rocks by J. Kourimsky (Good Photographs)
- Lecture hand-outs
- Research papers

SGLGCC2402: Structural Geology and Geotectonics *(4 Cr) (Major 2) Curriculum Details*

Pre-requisites:

Basic (10+2) knowledge of minerals and rocks. The course consists of field work on holidays; wherein student has to work independently. The field tour is a compulsory component of the course.

Course objectives:

1. To interpret the data and identify the structural features.
2. To train the students in identification of structural features, measurement of field data from the structures in the field, plotting and interpreting the data.
3. To train the students in understanding the mechanics of deformations.
4. Measurement of various orientation data from the structures, plotting them in suitable diagrams and make a quantitative analysis.
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes, Government and private organizations.
6. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization..

Course outcomes:

Students who earn minimum grade should be able to

1. Interpret the field data and interpret structures and deformations.
2. Identify and describe the structures at macroscopic, mesoscopic and microscopic level using specific nomenclature.
3. Understand and describe geometric features formed in the naturally deformed rocks and interpret the type of stress that developed the structure(s).
4. Portray 3D structures on map using different field data.
5. Work individually in the field and produce structural map of a region.
6. Explain the structural features of the region and thereby the geological history of the region.
7. Develop writing skills in writing home assignment, report etc which will be useful in research institutes/govt. organisations/pvt organizations.
8. Understand the methodology of carrying out scientific research in the field of structural geology and geotectonics.
9. Present his/her research findings in the seminars/conferences etc. or publish the research papers at national and international level

Curriculum Details: *(There shall be FOUR Modules in each course)* SGLGCC2402: Structural Geology and Geotectonics

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Stress-strain analysis**	**15**
	1.1	Stress-strain relationships for elastic, plastic and viscous materials; measurement of strain in deformed rocks; Mohr's circle and criteria for failure of rocks; ductile and brittle shears in rocks; kinematic and dynamic analysis of deformation; measurement of strain in deformed rocks.	
	1.2	Structural analysis of fold, cleavage, boudin, lineation, joint, and fault; stereographic projection of linear and planar structures; calculation of paleostress. Time relationship between crystallization and deformation.	
	1.3	Various states of stresses and their representation by Mohr circles. Techniques of strain analysis, Role of fluids in deformation processes	
	1.4	Rock fabrics- origin, significance, metamorphic tectonites, petrofabrics at microscopic level; use of stereographic and equal area projections.	
2.0		**Linear structures – Joints**	**15**
	2.1	Tectonic and non-tectonic joints, columnar and release joints, joint initiation and its mechanics.	
	2.2	Rock cleavages-axial plane cleavages, their significance, mechanics of rock cleavages.	
	2.3	Foliations and lineations; boudinage-types and significance; shear zones: types of shear zones; brittle-ductile and ductile structures in shear zones and their kinematic significance.	
	2.4	Shear zone rocks-mylonite, breccias, etc; planar and linear fabrics in deformed rocks-origin and importance.	
3.0		**Structural Features: Folds and Faults**	**15**
	3.1	Types and classification of Folds and Faults.	
	3.2	Identification of Folds and Faults in the field.	
	3.3	Mechanism of formation of Folds, Faults, Unconformities.	
	3.4	Application of structural features in other branches.	
4.0		**Geotectonics**	**15**
	4.1	Continents and Oceans: features & origin; Werner's concept of Continental Drift; Wilson cycle	
	4.2	Concept of plate, types of plates, plate driving forces, regional tectonic features: ridges, arcs and subduction zone with special reference to Indian examples, hot spots.	

	4.3	Plate collisions: types, products; tectonics of India with special reference to Himalaya plate convergence.	
	4.4	Indian continental deformation; structures at macroscopic level; deformation pattern and magma associations and associated economically important deposits.	
		Total	**60**

SGLGCP2402 Structural Geology and Geotectonics (1 Cr) Practical

1. Importance of contour diagrams, investigation and interpretation of geological maps.
2. Stereographic analysis of structural data.
3. Structural problems related to borehole data.
4. Stress-strain analyses.
5. Strain ellipsoids and their significance.
6. Analysing deformations at microscopic level and mesoscopic level.
7. Identification and interpretation of deformations in Deccan Trap and Eastern Dharwar Craton

Text Books and Reference Books:

- An Introduction to Structural Geology by A.K. Jain (Geological Society of India publication)
- An outline of Structural Geology by B.E. Hobbs, W.D. Means and P.F. Williams
- Analysis of Geological Structures by N.J. Price and J.W. Cosgrove
- Aspects of Tectonics -Focus on south central Asia by K.S. Valdiya
- Basic methods of Structural Geology by S. Marshak and G. Mitra
- Dynamic Himalaya by K.S. Valdiya
- Folding and fracturing of rocks by J.G. Ramsay
- Geological Structures of SEDVP by R.D. Kaplay, Md. Babar, P.R. Wesanekar and T. Vijay Kumar
- Geology, Vol. I, Strain Analysis, Academic Press.
- Geology, Vol. II, Folds and Fractures, Academic Press.
- Geology, Vol. III (Application of continuum mechanics), Academic Press.
- Geotectonics by V. V. Beloussov
- Global Tectonics. Third Edition (Reprint) by P. Keary, K.A. Klepeis and F.J. Vine
- Mapping of Geological Structures by K. McClay

- Mechanics in Structural Geology by B. Bayly
- Microtectonics by C.W. Passchier and R.A.J. Trouw
- Our Evolving Planet: Earths History in New Tectonics by K.N. Storetvedt
- Plate Tectonics and Crustal Evolution, 3rd Ed. by K.C. Condie
- Structural analysis of Metamorphic tectonites by F.J. Turner and L.E. Weiss
- Structural Geology by Marland P. Billings
- Structural Geology by H. Fossen (highly recommended)
- Structural Geology of Rocks and Region by G.R. Davis
- Structural Geology of Rocks and Regions by G.H. Davis and S.J. Reynolds
- Structural Geology: Fundamental and Modern by S.K. Ghosh
- Structure and Tectonics by P.C. Badgley
- Techniques of Modern Structural Geology: Folds and Fractures by J.G. Ramsay and M.I. Huber
- Tectonics and Structural Geology: Indian Context by Soumyajit Mukherjee
- Tectonics by Eldridge M. Moores and Robert J. Twiss
- The Dynamic Earth System by A.M. Patwardhan
- The Evolving Continents by B.F. Windley
- Understanding the Earth by I.G. Gass

SGLGCC2403: Palaeontology and Stratigraphy *(4Cr) (Major 3)*

Curriculum Details

Pre-requisites:

Basic (10+2) knowledge of biology.

Course objectives:

1. Study of paleontology with reference to animal and plant evolution.
2. Application of micropaleontology in oil industries.
3. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations/pvt.organizations.
4. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.
5. To understood the principles and concept of stratigraphy.
6. To train the students in identification of beds, formations, sedimentary structures, measurement of field, plotting and interpreting them.
7. To train the students to identify and correlate the formations.
8. Measurement of various orientation data from the structures, plotting them in suitable diagrams and make a quantitative analysis.
9. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organisations/Pvt. organizations.
10. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization

Course outcomes:

At the completion of the course student would be able to

1. Identify fossils based on morphological observations.
2. Correlate different stratigraphic units based on fossil record.
3. Classify and characterize different fossils.
4. Better understand origin and evolution of life.
5. Better understand the Palaeo-geography of India.
9. Use microfossils in the exploration for fossil fuels.
10. Understand principles of stratigraphic correlation
11. Correlate different strata based on different tools
12. Describe the utility of sequence stratigraphy in hydrocarbon exploration
13. Understand in detail the stratigraphy of India

Curriculum Details: *(There shall be FOUR Modules in each course)* SGLGCC2403: Palaeontology and Stratigraphy

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Paleontology**	**15**
	1.1	General classification of fossils.	
	1.2	Evolution - evolutionary pattern based on fossil record.	
	1.3	Stratigraphic range and distribution of invertebrate, vertebrate and plant fossils Fossil record with special reference to India.	
	1.4	Significance of marker fossils and fossil assemblages in stratigraphy.	
2.0		**Micropaleontology**	**15**
	2.1	Definition and scope of Micropaleontology.	
	2.2	Use of Micropaleontology in exploration of fossil fuels Equipments for micro-paleontological studies.	
	2.3	Foraminifera and Ostracoda - their morphology, orientations, growth, reproduction.	
	2.4	Ecology and palaeo-ecology, classification, evolutionary trends and stratigraphic distribution.	
3.0		**Stratigraphy- Introduction & Methods of Stratigraphic Correlations**	**15**
	3.1	Geological Time Scale. Stratigraphy- development of concept and principles of stratigraphy.	
	3.2	Facies Concept in Stratigraphy: Walther's Law of Facies; Concept of lithofacies and biofacies, Transgressions and regression.	
	3.3	Stratigraphic correlation: litho-stratigraphy, bio-stratigraphy, chrono-stratigraphy and magneto-stratigraphy; High Resolution stratigraphic correlation methods (e.g. core and well logging, chemostratigraphy).	
	3.4	Concept of Sequence Stratigraphy; Order and duration of sequences; Application of Sequence stratigraphy in hydrocarbon exploration.	
4.0		**Stratigraphy of India**	**15**
	4.1	Stratigraphy of cratons (Dharwar, Bastar, Singhbhum, Bundhelkhand and Aravalli); Stratigraphy of mobile belts (Eastern Ghat belt, Singhbhum-Chotanagpur belt, Delhi belt Central Indian Tectonic Zone, and Southern Granulite belt).	
	4.2	Stratigraphy of Proterozoic basins (Cuddapah and Kurnool basins, Vindhyan basin, Chattisgarh basin); Precambrian/ Cambrian boundary.	
	4.3	Stratigraphy of the marine Palaeozoic rock	

		formations of India; Permian/Triassic boundary; Stratigraphy of Indian Gondwana basins; Cretaceous/Tertiary boundary.	
	4.4	Stratigraphy of Palaeogene and Neogene systems in India; Epoch boundaries of the Cenozoic in India.	
		Total	**60**

SGLGCP2403 Palaeontology and Stratigraphy (1 Cr) Practical

1. Megascopic identification and description of invertebrate and vertebrate fossil specimens in the laboratory.

2. Collection, identification and description of different fossils from the field.

3. In Laboratory:

Study of rocks in hand specimens from known Indian stratigraphic horizons and type localities; Preparation of Stratigraphic correlation maps. Preparation of magneto-stratigraphic and chemo-stratigraphic maps and interpretations.

4. In Field:

Identification of lithofacies and biofacies in the field

Text Books and Reference Books:

- A Concise Dictionary of Paleontology by R. L. Carlton
- An introduction to fossils and minerals by Jon Erickson
- Basic Palaeontology by Michael J. Benton and David A.T. Harper
- Dynamics of the Earth System: Evolution, Processes and Interactions (2020) by
  - K. Pandey, (Ed), M. Ravichandran, (Ed) and N. Nair, (Ed)
- Elements of Micropaleontology by G. Bignot
- Fundamentals of Invertebrate Palaeontology by S. Jain
- Introduction to Marine Micropaleontology by Haq and Boersma
- Microfossils by M.D. Braiser
- Micropaleontology in Petroleum Exploration by R.W. Jones
- Micropaleontology: Principles and Applications by Pratul Kumar Sarswati and M. S. Srinibasan
- Nature through Time (2020) by Martinetto, E. (Ed), Tschopp, E. (Ed), Gastaldo, R. (Ed)
- Palaeontology (palaeobiology): Evolution and animal distribution by P.C. Jain and M.S. Anantharaman
- Principles of palaeontology by Stanley Raup
- Quaternary Environmental Micropaleontology by Simon K. Hasllett
- Vertebrate Palaeontology by Michael Benton
- A Manual of the Geology of India and Burma (Vols. I-IV) by E.H. Pascoe
- Depositional Sedimentary Environments by H.E. Reineck and I.B. Singh
- Fundamentals of historical geology and stratigraphy of India by G. R. Ravindra

Kumar

- Geology of India and Burma by M.S. Krishnan
- Geology of India: Volume 1 and Volume 2 by M. Ramakrishnan and R. Vaidyanathan
- Precambrian Geology of India by S.M. Naqvi and J.J.W. Rogers
- Principles of Sedimentology and Stratigraphy, (Fourth Edition) by Sam Boggs Jr.
- Principles of Sequence Stratigraphy by O. Catenuanu
- Principles of Stratigraphy by C.O. Danbar and J. Rodgers
- Seismic stratigraphy and global changes of sea level: American Association of petroleum Geologists by P.R. Vail, R. M. Mitchum, R. G. Todd, J. M. Widmier,

  S. Thompson, J.B. Sangree, J.N. Bubb and W.G. Hatlelid
- Seismic Stratigraphy- Applications to Hydrocarbon Exploration, Memoir of the American Association of Petroleum Geologists 26 by C.E. Payton
- Sequence Stratigraphy by D. Emery and K.J. Myers
- Stratigraphy: Principles and Methods by Robert, M. Schoch
- The Cenozoic Era? Tertiary and Quaternary by C. Pomerol
- The Geology of Stratigraphic Sequences by A.D. Miall
- The Making of India: Geodynamic Evolution by K. S. Valdiya
    - Unlocking the Stratigraphic Record by P. Doyle and M.R. Bennett

SGLGEC2401: Geochemistry *(3 Cr) (Elective 1) Curriculum Details*

Pre-requisites:

- Basic (10+2) knowledge of chemistry + good analytical skills

Course objectives:

1. The science of Geochemistry deals with the primordial distribution of elements in different spheres, their migration one sphere to another sphere and the rules governing the distribution and migration of elements.
2. Quantitative estimation of the distribution and migration of elements, in space and time, as the earth evolved.
3. Elements are the fundamental unit of all earth's spheres and also that of the planets of our Solar system.
4. Geochemistry is essential for the courses in igneous, sedimentary and metamorphic petrology, economic geology and for interpretation of geophysical data.
5. This course in Geochemistry would help the students to understand origin of elements, cosmic abundance of elements, what makes Earth's chemical composition unique, primary distribution of elements in different Earth's spheres, evaluate different processes of element migration and how physic-chemical conditions control elemental migration.
6. The course introduces stable and radioactive isotope geochemistry.

Course outcomes:

At the completion of the course student would be able to

1. Explain the origin of elements.
2. Explain distribution of elements in different spheres of the Earth.
3. Explain how the atomic properties of elements and their bonds determine the structure and composition of Earth's spheres.
4. Discuss the role of elements and their isotopes in evaluating Earth's processes.
5. Explain the geochemical processes controlling elemental distribution.
6. Graphical representation of element distribution.

Curriculum Details: *(There shall be FOUR Modules in each course)*

SGLGEC2401: Geochemistry

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction to Origin**	**15**
	1.1	Origin of elements; Elements and the periodic table.	
	1.2	Goldschmidt's classification; Cosmic abundance of elements.	
	1.3	Structure and composition of Universe and Solar system.	
	1.4	Meteorites-types and composition.	
2.0		**Distribution of Elements**	**10**
	2.1	Primordial distribution and chemical differentiation of the Earth .	
	2.2	Thermodynamic classification of elements.	
	2.3	Nernst-Berthelot partition coefficient and bulk partition coefficient; fractionation of elements in minerals/rocks.	
	2.4	Fick's laws of diffusion and activity composition relation (Roult's and Henry's law); Geochemistry of different spheres of Earth.	
3.0		**Introduction to Isotope Geochemistry**	**10**
	3.1	Half-life and decay equation .	
	3.2	Dating of minerals and rocks with potassium-argon, rubidium-strontium isotopes.	
	3.3	Dating of minerals and rocks with uranium-lead and isotopes.	
	3.4	Dating of minerals and rocks with samarium-neodymium isotopes.	
4.0		**Introduction to Isotope Geochemistry**	**10**
	4.1	Petrogenetic implications of samarium-neodymium systems.	
	4.2	Petrogenetic implications of rubidium-strontium systems .	
	4.3	Stable isotope geochemistry of carbon, oxygen and sulphur.	
	4.4	Their applications in geology; monazite chemical dating; Geochemical Cycle .	
		Total	**45**

SGLGEP2402: Geochemistry (1 Cr) Practical

1. Graphical representation of geochemical data.
2. Practical based on Trace element geochemistry.
3. Practical based on Stable and Radiogenic Isotope geochemistry.

Text Books and Reference Books:

- Essentials of Geochemistry (2nd Edition) by J. Walther
- Geochemistry by M. White
- Geochemistry Pathways and Processes (2nd Edition) by H. Y. McSween, S. M. Richardson and M. Uhle
- Inorganic Geochemistry - Principles and Applications (3rd Edition) by G. Faure
- Introduction to Geochemistry by Francis Albarede
- Introduction to Geochemistry - Principles and Applications by K. C. Misra
- Inorganic Geochemistry by Henderson
- Introduction to Geochemical Modeling by Francis Albarede
- Principles of Geochemistry by Brain Mason and Carleton B. Moore
- Using Geochemical Data: Evaluation, Presentation, Interpretation by Hugh Rollinson

SGLGCC2451: Igeneous Petrology and Sedimentary Petrology *(4 Cr) (Major 1) Curriculum Details*

Pre-requisites:

Basic (10+2) knowledge of chemistry and physics + completion of courses GEO-C101 (Mineralogy) and GEO-C104 (Geochemistry).

Course objectives:

This course in igneous petrology would help the students to understand

1. Origin of magmas in crust and mantle, evaluate different processes of magma generation
2. Role of temperature, pressure, depth and volatiles on magma composition
3. Application of thermodynamics in understanding igneous rocks
4. Evaluate the role of geochemistry in deciphering magma generation and evolution
5. Correlate magma compositions with plate boundaries.
6. Identify and characterize the igneous rocks based on their physical and textural characteristics.
7. To train the students in identification of beds, formations, sedimentary structures, measurement of field, plotting and interpreting them.
8. To train the students to identify and correlate the formations.
9. To train the students in measuring various orientation data from the structures, plotting them in suitable diagrams and make a quantitative analysis.
10. To teach geochemistry of sedimentary rocks.
11. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations/ Pvt. Organizations.
12. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization

Course outcomes:

At the completion of the course student would be able to

1. Explain generation of different mantle reservoirs.
2. Explain origin and differentiation of magmas.
3. Apply phase equilibria to the genesis of igneous rocks.
4. Utilize geochemistry in understating igneous processes.
5. Discriminate present- and palaeo-tectonic environments of igneous rocks.
6. Describe crust-mantle differentiation in space and time.
7. Decipher relationship between petrogenesis and ore genesis.
8. Identify and characterize igneous rocks based on megascopic and microscopic observations.
9. Graphically represent geochemical variations in magmas.
10. Correlate different sedimentary strata.
11. Evaluate sedimentary environments.
12. Evaluate the geochemical variations in sedimentary rocks.
13. Understand the sedimentary rocks.
14. Carry out Palaeocurrent analysis.
15. Identify and distinguish different sedimentary rocks.

SGLGCC2451: Igeneous Petrology and Sedimentary Petrology Curriculum Details: *(There shall be FOUR Modules in each course)*

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Igneous Petrology and its scope, Magma Generation, Evolution and Phase Equilibria**	**15**
	1.1	From Planetary evolution to the evolution of Lithosphere, Hydrosphere and Biosphere. Major Structural Units of the Earth Pressure Distribution within the Earth Temperature Distribution within the Earth.	
	1.2	Heat Sources for Magma Generation Physical Properties of the Magma Cooling/Crystallization of Magmas. Igneous Textures Classification Igneous Rocks.	
	1.3	Sites of Magma Generation Petrology and Geochemistry of Mantle Partial Melting and types of mantle melting, Primary Melts. Magmatic differentiation, Zone melting, Contamination, Mixing of magmas Magmas and Tectonic Environments Role of Geochemistry in Igneous Petrogenesis.	
	1.4	Gibb's and Mineralogical Phase Rule, One component system, Two component system. Three component system, Four component system, Role of Volatiles on Phase Equilibria.	
2.0		**Petrogenetic Suites and Associations**	**15**
	2.1	Komatiites, Basalts	
	2.2	Anorthosites, Layered Complexes	
	2.3	Ophiolites, Lamprophyres, Lamproites, Kimberlites, Carbonatites and Alkaline Rocks.	
	2.4	Andesites and Boninites, Granites.	
3.0		**Sedimentary Rocks and Process**	**15**
	3.1	Classification of sedimentary rocks; Processes and products of sedimentation .	
	3.2	Detrital sediments; Chemical precipitates; Volcano-clastic sediments .	
	3.3	Sedimentary structures and textures; Particle size of detrital rocks: Definition, measurement, size parameters, grain size distribution and causal factors .	
	3.4	Grain size distributions and environmental analysis, Sphericity and roundness, Packing and fabric, Porosity and permeability .	
4.0		**Depositional environments**	**15**

	4.1	Depositional environments and the sedimentary products .	
	4.2	Palaeocurrents and basin analysis; Basin shape, depth and sedimentation .	
	4.3	Geochemistry of sediments and sedimentary rocks; Source and process control on composition of Sedimentary rocks .	
	4.4	Plate tectonics and sedimentary rocks .	
		Total	**60**

SGLGCP2451: Igeneous Petrology and Sedimentary Petrology (1 Cr)

Practical

1. Study of Igneous Rocks in Hand Specimen.
2. Study of Igneous Rocks in Thin Section.
3. Binary and Ternary Variation Plots.
4. Tectonic discrimination plots.
5. Rare Earth Element and Incompatible Element Normalized Plots.
6. Study of Sedimentary Rocks in Hand Specimen.
7. Study of Sedimentary Rocks in Thin Section.
8. Grain size and grain shape analysis of sediments.

Text Books and Reference Books:

- An Evolution of Igneous Rocks by N. L. Bowen (*Classical text based on Experimental Petrology*)
- Atlas Igneous Rocks and their Textures by McKenzie, Donaldson and Guilford (*Excellent book on texture illustrations*)
- Essentials of Igneous and Metamorphic Petrology by B. Ronald Frost and Carol D. Frost
- Igneous and Metamorphic Petrology by Best (*Rock Associations*)
- Igneous and Metamorphic rocks under Microscope by Shelly (*Good introductory book on petrography*)
- Igneous Petrogenesis and Global Tectonic Environments by Marjorie Wilson (*Advanced Text on rock associations and tectonic environments*)
- Igneous Petrology by Anthony Hall (*Phase Equilibria*)
- Igneous Petrology by D. S. Barker (*Good general text book*)
- Igneous Petrology by McBirney (*Textures & Rocks*)
- Igneous Rocks by Gupta (*With Indian examples*)
- Inorganic Geochemistry by Henderson (*Good introductory book on Geochemistry principles*)
- Introduction to Geochemical Modeling by Francis Albarede (*Advanced book on geochemical modeling)*)

- Petrography by William, Turner and Gilbert (*Good introductory book on petrography*)
- Petrologic phase equilibria by W.G. Ernst
- Petrology by Nockolds, Knox and Chinner (*Classic introductory book*)
- Petrology by Raymond (*Good introductory book*)
- Petrology of Igneous Rocks by Hatch, Wells and Wells (*Good introductory book*)
- Petrology of Igneous, Sedimentary and Metamorphic Rocks by Ehlers and Blatt (*Good introductory book*)
- Phase Diagrams by A. R. Morse (*Good introductory book on phase equilibria*)
- Principles of Geochemistry by G. Faure (*Advanced book on Geochemistry principles*)
- Principles of Igneous & Metamorphic Petrology by A. R. Philpotts (*physical properties of Magma*)
- Principles of Igneous and Metamorphic Petrology by Anthony Philpotts and Jay Ague
- Principles of Igneous and Metamorphic Petrology by John D. Winter
- Principles of Igneous Petrology by Maaloe (*Good Theoretical text*)

The Principles of Petrology by G. W. Tyrrell (*Basic introductory book*)

- Applied Sedimentology by Richard C. Selly
- Atlas of Sedimentary Rocks Under the Microscope by A. E. Adams, C. Guilford, and W. S. MacKenzie
- Depositional Sedimentary Environments by H.E. Reineck and I.B. Singh
- Geochemistry of Sediments and Sedimentary Rocks: Evolutionary Considerations to Mineral Deposit- Forming Environments Edited by David Lentz
- Origin of sedimentary rocks by Harvey Blatt
- Petrography by William, Turner and Gilbert (*Good introductory book on petrography*)
- Petrology by Nockolds, Knox and Chinner (*Classic introductory book*)
- Petrology by Raymond (*Good introductory book*)
- Petrology of Igneous, Sedimentary and Metamorphic Rocks by Ehlers and Blatt (*Good introductory book*)
- Petrology of sedimentary rocks by Sam Boggs
- Physical Principles of Sedimentology by Kenneth J. Hsü
- Principles of Sedimentology and Stratigraphy by Sam Boggs
- Sedimentary geology by Donald Prothero
- Sedimentary Petrology: An Introduction to the Origin of Sedimentary Rocks by Maurice E. Tucker

- Sedimentary Provenance and Petrogenesis: Perspectives from Petrography and Geochemistry (GSA special paper) by José Arribas, Mark J. Johnsson and

  Salvatore Critelli

- Sedimentary Rocks by F.J. Pettiohn
- Sedimentary Rocks by Holly Cefrey
- Sedimentary Rocks by Rebecca Pettiford

- Sedimentary rocks in the field by Maurice Tucker
- Sedimentary Rocks in the Field: A Colour Guide by D. A. V. Stow
- Sedimentology and Stratigraphy by Gary Nichols

- Sedimentology by Michael McLane

SGLGCC2452: Thermodynamics and Metamorphic Petrology *(4 Cr) (Major 2) Curriculum Details*

Pre-requisites:

Basic (10+2) knowledge of chemistry and physics + completion of courses GEO-C101 (Mineralogy) and GEO-C104 (Geochemistry).

Course objectives:

This course in thermodynamics and metamorphic petrology would help the students to understand

1. Application of thermodynamics to understand metamorphic processes.
2. Formation of metamorphic rocks as controlled by pressure-temperature changes in the deep Earth consequently they are the windows to deep Earth composition, structure and processes.
3. Significance of metamorphic rocks to understand crustal differentiation. Study of metamorphic rocks to evaluate crust differentiation in space and time.
4. Significance of metamorphic rocks to our understanding of vertical and horizontal tectonics of planet Earth.
5. The role of volatiles consumed and released during formation of metamorphic rocks for the continuation of plate tectonics and subduction zone magmatism and formation of many ore deposits.
6. Metamorphism as the fundamental process of altering earlier minerals and formation of new minerals stable in the changed physico-chemical conditions.

Course outcomes:

At the completion of the course student would be able to

1. Apply principles of Thermodynamics to metamorphic processes.
2. Explain elemental diffusion and formation of new minerals.
3. Explain differentiation of continental crust.
4. Discriminate present- and palaeo-tectonic environments of metamorphic rocks.
5. Identify and characterize metamorphic rocks based on megascopic and microscopic observations.
7. Graphically represent mineralogical variations in metamorphic rocks.

SGLGCC2452: Thermodynamics and Metamorphic Petrology Curriculum Details: *(There shall be FOUR Modules in each course)*

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Thermodynamics**	**15**
	1.1	System, Phase, Component and Phase Rule, Enthalpy, Entropy and Gibb's Free Energy.	
	1.2	1^{st}, 2^{nd} and 3^{rd} Laws of Thermodynamics Reaction kinetics.	
	1.3	Clausius - Clapeyron Equation and Calculation of Reaction Boundaries, Geothermobarometry.	
	1.4	Psuedosections, P-T-t Path.	
2.0		**Introduction to Metamorphism**	**15**
	2.1	Metamorphism as a process of Earth's differentiation, Metamorphic processes.	
	2.2	Role of P/T conditions and fluids in metamorphism, Deformation associated with metamorphism.	
	2.3	Migmatites and partial melting, Metamorphic structures and textures.	
	2.4	Geochemistry of metamorphic rocks.	
3.0		**Metamorphic rocks: Grades, Zones and Facies**	**15**
	3.1	Types of metamorphism and their products.	
	3.2	Metamorphic grades, Metamorphic zones.	
	3.3	Metamorphic facies concept.	
	3.4	Experimental studies on metamorphic reactions, Characteristics of important metamorphic reactions.	
4.0		**Plate tectonics ad Metamorphic rocks**	**15**
	4.1	Zeolite- and lawsonite-bearing rocks, Greenstones facies.	
	4.2	Amphibolites, Granulites facies.	
	4.3	Glucophane schists, Eclogites facies.	
	4.4	Paired metamorphic belts, Metamorphic rocks in space and time.	
		Total	**60**

SGLGCP2452: Thermodynamics and Metamorphic Petrology (1 Cr)

Practical

1. Study of Metamorphic Rocks in Hand Specimen.
2. Study of Metamorphic Rocks in Thin Section.
3. AKF, ACF and AFM projections.
4. Estimation of P-T conditions based on coexisting minerals.

Text Books and Reference Books:

- An Introduction to Metamorphic Petrology by Bruce W.D. Yardley
- Atlas Metamorphic Rocks and their Textures by McKenzie, Donaldson and Guilford (*Excellent book on texture illustrations*)
- Essentials of Igneous and Metamorphic Petrology by B. Ronald Frost and Carol D. Frost
- Igneous and Metamorphic Petrology by Best (*Rock Associations*)
- Igneous and Metamorphic rocks under Microscope by Shelly (*Good introductory book on petrography*)
- Paired Metamorphic Belts by Miyashiro
- Petrography by William, Turner and Gilbert (*Good introductory book on petrography*)
- Petrology by Nockolds, Knox and Chinner (*Classic introductory book*)
- Petrology by Raymond (*Good introductory book*)
- Petrology of Igneous, Sedimentary and Metamorphic Rocks by Ehlers and Blatt (*Good introductory book*)
- Phase Diagrams by A. R. Morse (*Good introductory book on phase equilibria*)
- Principles of Igneous & Metamorphic Petrology by A. R. Philpotts (*Thermodynamics and Facies concept)*
- Principles of Igneous and Metamorphic Petrology by Anthony Philpotts and Jay Ague
- Principles of Igneous and Metamorphic Petrology by John D. Winter

SGLGCC2453: Environmental Geology *(4 Cr) (Major 3)*

Curriculum Details

Pre-requisites:

Basic (10+2) knowledge of geology, chemistry and physics.

Course objectives:

1. Introduce environmental perspective to the geology students.
2. Introduce geology as a tool in the control of environmental pollution.
3. Equip the student with knowledge for societal needs.

Course outcomes:

At the completion of the course student would be able to

1. Understand Air, Water and Soil pollutants.
2. Apply geological methods in pollution control.
3. Select sites for geological disposal of pollutants.
4. Analyze Air, Water and Soil samples for their chemistry..

SGLGCC2453: Environmental Geology Curriculum Details: *(There shall be FOUR Modules in each course)*

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction and Ecology**	**15**
	1.1	Introduction, Fundamental Concepts of Environmental Geology: Present is a key to the future.	
	1.2	Concepts of Lithosphere and Atmosphere and their Physico-chemical characteristics	
	1.3	Concepts of Hydrosphere and their Physico-chemical characteristics.	
	1.4	Ecology- its meaning and Scope, Ecosystem Concept, Energy Flow in Ecosystem, Food chain and Food web, Ecological pyramid.	
2.0		**Air Pollution**	**15**
	2.1	Classification of Air Pollutants, Sources of Air Pollutants.	
	2.2	Indoor Air Pollution, Air Pollution and Meteorology, Air Quality Monitoring.	
	2.3	Consequences of Air Pollution-Acid Rain, Ozone Depletion.	
	2.4	Green House Effect and Global Warming, Effects of Air Pollution on life.	
3.0		**Water and Soil Pollution**	**15**
	3.1	Types of water pollutants- physical, chemical, biological, Classification of pollutants- Inorganic pollutants, organic pollutants, Biological pollutants, sediments, Oxygen demanding waste, Disease causing agents, Radioactive pollutants.	
	3.2	Sources of water pollution- Point sources, Non point sources, Natural and Anthropogenic sources, Sewage and domestic waste, Industrial effluent, Agricultural discharges, Fertilizers, Pesticides, Detergents, Herbicides, Toxic metals, Thermal pollutants.	
	3.3	Types of pollution- Groundwater pollution, Surface water pollution- Lake water pollution, River water pollution, Eutrophication, Marine pollution, Effect on life..	
	3.4	Definition, Composition of Soil, Soil formation, Soil profile, Types of Soils, Pedogenic processes, Texture of Soil, Soil pH, saline and alkaline Soil, Cation Exchange capacity, Soil pollution by- urban waste, agricultural practices, chemical and metallic pollutants, Industrial effluent, Detrimental effects on Soil, Integrated Pest Management.	
4.0		**Pollution Control and Solid Waste**	15

	4.1	Pollution Control for Air.	
	4.2	Water and Soil- Decontamination Procedures and Methods, Remedial Measures and role of Geology.	
	4.3	Solid, Liquid, Hazardous Waste Disposal and management, Geological solutions for environmental problems, Geological factors in selection of Sites for Disposal.	
	4.4	Environmental Impact Assessment (EIA).	
		Total	**60**

SGLGCP2453: Environmental Geology (1 Cr) Practical

1. Physico-Chemical analysis of Water and Soil.
2. Plotting of Data.
3. Calculation of Different Ratios for Water Quality Assessment.

- ***Text Books and Reference Books:***

- Air Pollution by B. K. Sharma
- An Introduction to Environmental Pollution by B. K. Sharma
- Environmental Geology by Carla W. Montgomery
- Environmental Geology by K. S. Valdiya
- Environmental Geology, Handbook of Field Methods and Case Studies by Klaus Knödel, Gerhard Lange and Hans-Jürgen Voigt
- Environmental pollution and control by P. Aarne Vesilind
- Environmental Pollution Monitoring and Control by Shripad Moreshwar Khopkar
- Fundamentals of Soil Science by Henry D. Foth

SGLGEC2451: Computer Applications in Geology *(3 Cr)*
(Elective 1) Curriculum Details

Pre-requisites:

Basic knowledge of Geology and Computer + Basic Software.

Course objectives:

1. Teach fundamental concepts in computer organization and growth.
2. Teach application of computers and software in geological sciences.
3. Teach Basic computer programming and software relevant to geology.

Course outcomes:

At the completion of the course student would be able to

1. Use MS Office in processing and presenting geological data.
2. Prepare geological maps using Adobe Illustrator and Coral Draw.
3. Process large amount of geological data.
4. Apply ANN to evaluate geological data.

SGLGEC2451: Computer Applications in Geology Curriculum Details: *(There shall be FOUR Modules in each course)*

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction**	**15**
	1.1	Computer organizations, architecture and peripherals.	
	1.2	Types of computers; Computer generations, Concept of operating system.	
	1.3	MS office – Word, Excel.	
	1.4	Power point; Internet.	
2.0		**Computer programmes**	**10**
	2.1	Computer programmes useful for geoscientific studies: application of Surfer, Use of Grapher, Excel, etc.	
	2.2	Windows-based software applications, including word-processing, spreadsheets.	
	2.3	Graphic image manipulation, drawing, presentations (MS-Excel, Power Point, Adobe Illustrator, CorelDraw, Photoshop).	
	2.4	Elementary concepts on Knowledge Based Expert System, Decision Support System, Neural Network, Fuzzy Logic and Genetic Algorithm.	
3.0		**Use of computers and software**	**10**
	3.1	Use of computers and software as tools in the areas of geology.	
	3.2	Use of computers and software as tools in the areas of geological problem-solving, report-writing, and presentations.	
	3.3	Specific applications in Geological studies .	
	3.4	Geological field data plotting software.	
4.0		**Use of computers and software**	**10**
	4.1	Database - definition, structure, and types.	
	4.2	Geological database.	
	4.3	Construction of geological maps and sections using Adobe Illustrator and Coreldraw.	
	4.4	Use of Software Packages in Geology.	
		Total	**45**

SGLGEP2451: Computer Applications in Geology (1 Cr) Practical

1. Mastering MS Office.
2. Processing Large Data Sets using relevant software.
3. Use of Adobe Illustrator and Corel Draw for geological maps and sections.
4. Geological data plotting and interpretation by using softwares.

Text Books and Reference Books:

- Computer Application in the Earth Sciences by Daniel Merriam
- Computer Applications in Petroleum Geology by Joseph E. Robinson
- Computer Applications in the Earth Sciences by Merriam, Daniel (Ed.)
- Computer Fundamentals by Pradeep K. Sinha and Preeti Sinha
- Computer Modeling of Geologic Surfaces and Volumes (AAPG computer applications in geology) by David E. Hamilton
- Fundamentals of Computer by V. Rajaraman
- Use of Microcomputers in Geology (Computer Applications in the Earth Sciences) by Hans Kürzl and Daniel F. Merriam (Editors)

SGLGEC2452: Geomorphology and Morphotectonics *(3 Cr)*
(Elective 2) Curriculum Details

Pre-requisites:

Basic (10+2) knowledge of surface geological processes, geographical landforms and Geotectonics + good observational skills.

Course objectives:

1. Identification of different geomorphological features and their mode of formation.
2. Exogenous processes and natural agents controlling the surface geology.
3. Concept of landform development and their stages of evolution with time.
4. Continental drift and plate tectonics on global scale.
5. Mode of formation of continental and oceanic crust and their interaction during plate movement.
6. Identification of different tectonic features globally.
7. Endogenous processes and driving forces controlling the tectonic features.
8. Drainage basin analysis and their application.
9. Morphometric and morphotectonic analyses to evaluate landform tectonically active or not.

Course outcomes:

Students who earn minimum grade should be able to

1. Identify of geomorphological features and their controlling natural agents.
2. Understand the processes of geological weathering and erosion and their acceleration rates at different climatic condition.
3. Understand the mechanism of soil formation and their types.
4. Lithospheric plate movement and their driving forces.
5. Lithospheric plate interaction and their products.
6. Regional tectonic features and their controlling mechanisms.
7. Morphometric analyses to evaluate surface geology.
8. Morphotectonic analyses to evaluate land surface tectonically active or not.
9. Different structural features and their orientation to understand tectonic correlation.

SGLGEC2452: Geomorphology and Morphotectonics

Curriculum Details: ***(There shall be FOUR Modules in each course)***

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Surface Geology**	
	1.1	Evolution of Earth; Principle of uniformitarianism; origin, differentiation and internal structure of the Earth and their reflections on surface geology; origin of atmosphere.	**15**
	1.2	Weathering processes and products. geological action of rivers, wind, glaciers, waves; erosional and depositional landforms.	
	1.3	Major geomorphic features of India- coastal, peninsular and extra-peninsular.	
	1.4	Formation of soil, physiographic features and river basins in India. Hydrographs and flood frequency analysis.	
2.0		**Geotectonics**	
	2.1	Concepts of Continental drift, sea-floor spreading, Isostasy, orogeny and plate tectonics.	**10**
	2.2	Earth's internal structure; earthquakes and volcanoes; hot spot and mantle plume.	
	2.3	Concept of plate, types of plates, Plate driving forces, Plate collision: types, products; Wilson cycle.	
	2.4	Regional tectonic features of continents and ocean; Himalaya formation; Deccan trap formation.	
3.0		**Tectonic Geomorphology**	
	3.1	Geotectonic endogenous process and features.	**10**
	3.2	Folds and faults,.	
	3.3	Joints and fractures.	
	3.4	Volcanoes.	
4.0		**Tectonic Geomorphology**	
	4.1	Global morphotectonics, local morphotectonics.	**10**
	4.2	Drainage patterns; Morphometric and morphotectonic analyses.	
	4.3	Drainage basin morphometry; morphometric parameters; morphometric analysis case studies.	
	4.4	Structural and lithological controls of landforms and drainage patterns; concept of neo-tectonics.	
		Total	**45**

SGLGEP2452: Geomorphology and Morphotectonics (1 Cr)

Practical

1. Geomorphological landforms models
2. Introduction to topographical maps
3. Geomorphological and geological map symbols
4. Regional tectonic feature identification on tectonic maps
5. Drainage basin analysis
6. Morphometric analysis parameters
7. Morphotectonic analysis parameters
8. Structural features and their orientation
9. Strike and dip calculation..

Text Books and Reference Books:

- Aerial photographs in field geology by L.H. Lattman and R.G. Ray
- Geomorphology: A systematic Analysis of Late Cenozoic Landforms by A.L. Bloom
- Introducing Physical Geography by Alan Strahler
- Introduction to Physical Geology by Thompson and Turk.
- Morphotectonics by Adrian E. Scheidegger.
- Physical Geology by Diane H. Carlson, Charles C. Plummer and Lisa Hammersley
- Principles of Geomorphology by William D. Thornbury
- Process Geomorphology by D.F. Ritter, R.C. Kochel and J.R. Miller
- Tectonic Geomorphology by Douglas W. Burbank and Robert S. Anderson
- Terrain Analysis by D.S. Way

SGLGCC2501: ECONOMIC GEOLOGY AND GEOLOGY OF INDIAN MINERAL DEPOSITS (Theory: 4 credits & Practical: 2 credits)

Pre-requisites:

Basic (10+2) knowledge of chemistry and physics + completion of courses GEO-C101 (Mineralogy), GEO-C104 (Geochemistry), GEO-C201 (Igneous Petrology), GEO-C202 (Thermodynamics and Metamorphic Petrology) and GEO-C203 (Sedimentary Petrology).

Course objectives:

1. Economic Geology is very significant branch of geology directly linked to National Economy.
2. This course in Economic Geology and Indian Mineral Deposits would help the students to understand distribution of economic minerals in Earth's crust, evaluate different processes of economic mineral formation, identify and characterize the minerals based on their physical, chemical and optical properties.
3. The student will study the basic principles behind the formation of ore deposits; how crustal abundance, physic-chemical conditions and fluids play a significant role in the formation of mineral deposits.
4. The course deeply discusses the spatio-temporal and tectonic controls of ore formation both at global level and especially in Indian context.
5. The course offers a detailed account of Indian mineral deposits.
6. The student will study how to identify the most common ore minerals in hand specimen and, by using optical techniques learn how to identify the common ore minerals in thin section.

Course contents:

Module No. 1: Introduction, Classification and Processes of Ore Formation

Introduction to the Ore deposits,Concept of ore bearing fluids, their origin and migration, Form, mineral assemblage, rock-ore association and relationship, Physical and optical properties of ore minerals, Ore textures, Wall-rock alteration, Classification of Ore deposits, Processes of Ore formation, Magmatic, Sublimation Hydrothermal, Oxidation and Supergene Sulfide Enrichment, Residual and Mechanical Concentration, Sedimentation, Evaporation, Contact Metamorphism, Regional Metamorphism, Bacteriogenic, Fluid inclusions in ore mineral assemblage Stable isotopes in ore genesis

Module No. 2: Controls on Ore Formation

Structural, physic-chemical and stratigraphic controls of ore localization Paragenesis and Zoning, Stratiform and Stratabound deposits Metallogenic Epochs and Metallogenic Provinces Platetectonic controls on Distribution of Ore Deposits

Module No. 3: Indian Ore deposits: Metallic Deposits

Geologic setting, field occurrence, ore mineralogy, association, geochemistry, genesis and tectonic environment of Cu, Pb, Zn, Fe, Mn, Cr, Al, Ba, Sn, W, Mo, Au, Ag, Ni, PGE, Be, Hg, Mg, P

Module No. 4: Indian Ore deposits: Non-Metallic Deposits

Geologic setting, field occurrence, ore mineralogy, association, geochemistry, genesis and tectonic environment of Industrial minerals used in Refractory industry, Fertilizer industry, Ceramic industry, Cement industry, Chemical industry, Glass industry, Paint industry, Abrasives, Building stones, Diamond and other precious and semi precious stones

SGLGCP2501: Practical based on GEO-C301 (2 Credits)

1. Study of ore minerals and industrial materials in hand specimens.
2. Study of characteristics structures observed in hand specimens.
3. Study of ore minerals, textures and structures in thin and polished sections.
4. Preparation of maps showing distribution of metallic and industrial minerals in India and also classical world mineral deposits.

Course outcomes:

At the completion of the course student would be able to

1. Describe geological distribution of a variety of ore deposits.
2. Understand different processes of mineral deposit formation.
3. Explain why certain ore deposits are restricted to certain epochs, provinces and tectonics.
4. Give a detailed account of Indian mineral deposits.
5. Identify and characterize ore minerals based on megascopic and microscopic observations.
6. Prepare global and Indian mineral deposit distribution.

Prescribed and Reference Books

- Economic Geology Principles and Practice: Metals, Minerals, Coal and Hydrocarbons – Introduction to Formation and Sustainable Exploitation of Mineral Deposits by Walter L. Pohl
- Economic Mineral Deposits by Mead L. Jensen and Alan M. Bateman
- Geochemistry of Hydrothermal Ore Deposits by H.L. Barnes
- Hand Book of Stratabouond and Stratiform Ore Deposits by Wolf, K.H. (1976-1981)
- Introduction to Ore-forming processes by L. Robb
- Metals and Society: An Introduction to Economic Geology by Nicholas Arndt, Stephen Kesler and Clément Ganino
- Mineral Economics: An Indian Perspective by Kirtikumar Randive and Sanjeevani Jawadand
- Mineral Resources, Economics and the Environment by S.E. Kesler and A.C. Simon
- Minerals and Allied Natural Resources and their Sustainable Development: Principles, Perspectives with Emphasis on the Indian Scenario (Springer Geology) by Mihir Deb and Sanjib Chandra Sarkar
- Ore Genesis – A Holistic Approach by A. Mookherjee
- Ore Geology and Industrial Minerals – An Introduction by A.M. Evans
- Ore microscopy and ore petrography by James R. Craig and David J. Vaughan
- Ore Petrology by R.L. Stanton
- The Geology of Ore Deposits by J.M. Guilbert and C.F. Park Jr.

The Ore Minerals and their Intergrowths by P. Ramdohr

- The World of Mineral Deposits: A Beginner's Guide to Economic Geology by
- Time and Strata Bound Ore Deposits by D.D. Klemm and H.J. Schneider

SGLGCC2502: HYDROGEOLOGY
(Theory: 4 credits & Practical: 2 credits)

Pre-requisites:

Basic (10+2) knowledge of chemistry and physics + completion of courses GEO-C101 (Mineralogy), GEO-C102 (Structural Geology and Geotectonics) and GEO-C104 (Geochemistry) and GEO-C203 (Sedimentary Petrology).

Course objectives:

1. To understood the hydro-geological cycle.
2. Occurrence of groundwater on the planet earth.
3. To study the groundwater aquifers, hydro geological properties, and movement of groundwater.
4. Exploration of groundwater occurrence in different geological formations.
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations/Pvt. organizations
6. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.

Course contents:

Module No. 1:

Hydrological cycle; Occurrence and distribution of groundwater; Aquifer classification and characteristics of aquifers, Hydrological properties of rocks- Porosity, permeability, hydraulic conductivity, specific yield, storage coefficient, transmissibility, hydraulic resistivity, hydraulic diffusivity.

Module No. 2:

Classification of rocks from hydrological view- Properties; groundwater conditions in different geological formations. Aquifer parameter analysis; Darcy's Law in homogenous and heterogenous media; Bernoulli equation; Reynold's number; pumping test and aquifer evaluations; Coastal conditions- seawater intrusion and its control;

Module No. 3:

Groundwater management; methods of recharge; artificial recharge; water budgeting and evaluation of perennial yield; Urbanization and demands on water; Water logging and conjunctive use; excessive use and alkalinity-saltation; Methods of water conservation; sustainable watershed development; groundwater level fluctuations; land subsidence; impact of global climate change on groundwater.

Module No. 4:

Groundwater chemistry: Chemical characteristics of groundwater in relation to various uses – domestic, industrial and irrigation; Radioisotopes in hydro-geological studies; Groundwater contamination and problems of arsenic, fluoride and nitrates.

Groundwater exploration: Surface investigation of groundwater - geologic, remote sensing, electrical resistivity, seismic, gravity and magnetic methods; sub-surface investigation of groundwater - test drilling, resistivity logging, spontaneous potential logging, radiation logging.

SGLGCP2502: Practical based on GEO-C302 (2 Credits)

In Laboratory:

Megascopic identification and description of hydrological properties of rocks. Hydrological problems, hydrochemical analysis of water, plotting the Gibb's diagrams, Piper Tri-linear diagrams etc.

In Field:

Study of weathering pattern with respect to percolation of surface water in to the ground water, study of primary and secondary porosity of rock formation; Well inventory etc.

Course outcomes:

At the completion of the course student would be able to

1. Understand Water-bearing formations.
2. Understand and model the flow of groundwater.
3. Explain chemistry of groundwater as controlled by natural and anthropogenic processes.
4. Detect groundwater potential and understand its management.
5. Analyze water for different chemical components.
6. Graphically represent variations groundwater chemistry.

Prescribed and Reference Books

- Geochemistry, Groundwater and Pollution by C.A.J. Appelo
- Geophysical Prospecting For Groundwater by Sankar Kumar Nath
- Ground Water and Wells by F.G. Driscoll
- Ground Water by H.M. Raghunath
- Ground Water Hydrology by D.K. Todd
- Groundwater Geochemistry by J. Merkel Broder
- Groundwater Geophysics in Hard Rock by Prabhat C. Chandra
- Groundwater Prospecting and Management by H. P. Patra, Shyamal Kumar Adhikari, and Subrata Kunar
- Hydrogeology by S.N. Davies and R.J.N. Dc-West
- Modern Groundwater Exploration: Discovering New Water Resources in consolidated Rocks Using Innovative Hydrogeologic Concepts, Exploration, Drilling, Aquifer Testing and Management Methods by Jay H. Lehr and Robert A. Bisson

SGLGCC2503: REMOTE SENSING and GEOGRAPHICAL INFORMATION SYSTEMS (Theory: 4 credits & Practical: 2 credit)

Pre-requisites:

Basic understanding Geology, Geography and Physics (10 / 10+2 level).

Course objectives:

1. To attain fundamental knowledge of basics of Remote Sensing.
2. To identify different features with the help of Photo-interpretation Elements.
3. To apply Remote Sensing knowledge for different applications in Earth Sciences.
4. Introduce the students to the fundamental concepts of GIS and GPS technologies
5. It will make them familiar with the most essential GIS techniques with hands on practical experience.
6. Students will learn about creation and organization of spatial and non-spatial data.
7. Learn and use different GIS based techniques to identify and solve the natural, environmental and community problems.
8. Learn application of GIS and GPS in geology.

Course contents:

Module No. 1: Introduction and Aerial Photography:

Introduction to Remote Sensing, Definition, Characteristics of EMR, Platforms, Fundamentals of Aerial Photography, History of Aerial Photographs, Types of Aerial Photographs- Vertical and Oblique Photographs, Aerial Cameras, Flying Plan, Photogrammetry -- Basic Geometric Characteristics- Scale, Overlap, Tilt, Distortion and Displacement of Aerial Photographs, Advantages and Disadvantages of Aerial Photographs, EMR and its interaction with matter, Reflection, Absorption, Transmission, Scattering. Concept of Signatures- Photo Interpretation Elements.

Module No. 2: Satellite Remote Sensing and Applications of Remote Sensing:

Principles of Remote Sensing, Process of Remote Sensing, Indian Remote Sensing Programme, Types of Satellites- Sun-synchronous and Geostationary Satellites, Launch Vehicles- PSLV, GSLV, Payloads, Active and Passive Remote Sensing, Classification of Remote Sensors, Resolution- Spatial, Spectral, Radiometric, Temporal, Microwave Sensors, SLAR, Digital Image Processing- Image Classification, Supervised and Unsupervised Classification, Image Enhancement, Filtering, PCA etc.

Applications of Remote Sensing:

Interpretation of Visual and Digital data, Applications in Geology.

Module No. 3:

Introduction to GIS, Definition, History of GIS, Scope and Importance of GIS, Development of GIS, Components of GIS, Data models in GIS - Raster data model, Vector data model, basic entities of GIS: line, point and polygon, Geodatabase, Map Projection, Types and Need of projection system, Spatial and Attribute data, Acquisition of spatial data: Scanning, Georeferencing, concept of layer, digitizing, error detection and correction, DBMS.

Module No. 4: Global Positioning Systems, History and developments in GPS, Trilateration process, types of GPS, GPS Surveys, Mapping and layout, Image processing, General

processes involved in image processing, mosaic, subset, Point interpolation techniques: Krigging, IDW, Data analysis, network analysis, DEM and DTM, Thematic maps, Geological Applications of GIS and GPS technology

SGLGCP2503: Practical based on GEO-C303 (1 Credit)

1. Toposheet Reading
2. Calculation of the Scale of Aerial photograph and Satellite Imagery.
3. Identification of different features from the Aerial photograph with the help of Photo-interpretation Elements.
4. Identification of different features from Satellite Imagery with the help of Photo-interpretation Elements.
5. Study of Drainage patterns from Aerial Photograph/Satellite Imagery.
6. Preparation of Land use/Land cover Map from Aerial Photograph/Satellite Imagery.
7. Calculation of Land use/Land cover percentage from Aerial Photograph/ Satellite Imagery.
9. Geo-referencing of image.
10. Base layer preparation.
11. Error detection and correction.
12. Preparation of geodatabase and editing data.
13. Use of GPS instrument to collect way-point data.
14. Map Projections.
15. Importing GPS data into the computer using software.
16. Mosaiking.
17. Subsetting.
18. Point Interpolation techniques: Krigging, IDW.
19. Preparation of DEM/DTM.
20. Preparation of thematic maps
21. Practical based on geological applications of GIS.
22. Practical based on geological applications Google Earth.

Course outcomes:

At the completion of the course student would be able to

1. Explain the Fundamental principles of Remote Sensing.

2. Explain basic properties of Remote Sensing, Data acquisition, Storage and Processing.
3. Identify different features with the help of Photo interpretation Elements.
4. Apply the knowledge of Remote Sensing for applications in different fields.
    1. Differentiate between different data types in GIS.
    2. Georeference the spatial data and work on spatial and non-spatial database.
    3. Describe various GIS tools and techniques.
    4. Explain the fundamental principles behind GPS technology.
    5. Visualize GIS outputs in different dimensions.
    6. Create digital GIS maps.

    7. Apply spatial data analysis for various applications to deal with geological problems.

Prescribed and Reference Books

- Image Interpretation in Geology by Drury
- Introduction to Remote Sensing by J. B. Campbell
- Photogrammetry by Miller and Miller

- Principles & Applications of Photogeology by S. N. Pande
- Remote Sensing & Image Interpretation by T. M. Lillesand and W. K Ralph
- Remote Sensing in Geology by Siegal
- Remote Sensing: Principles and Interpretation by F. F. Sabins

- An Introduction to Geographical Information Systems by I. Heywood, S. Cornelisus and S. Carver
- Concepts Techniques of Geographical Information Systems by C. P. Lo and A. W. Yeung Geographical Information Systems and Science by P. A. Longley, M. F. Goodchild, D. J. Maguire and D. W. Rhind
- Fundamentals of Geographic Information Systems by M. N. Demers
- Introduction to Geographic Information Systems by K. T. Chang
- Introduction to Global Positioning Systems by Ahmed E. L. Rabbany
- Introductory Digital Image Processing by J. R. Jensen
- Textbook of Remote Sensing and Geographic Information System by M. Anji Reddy
- Principles of Geographical Information Systems by P. A. Burrough and R. A. McDonnell

The GIS Book by G. B. Korte

SGLGEC2501: PRINCIPLES OF GEOPHYSICS
(Theory: 3 credits & Practical: 1 credit)

Pre-requisites:

Basic knowledge about physical properties like density, magnetism, electrical properties, elastic and radioactive properties, general composition of the earth materials and their physical property variations.

Course Objectives:

The objective of this course is to develop basic knowledge of geophysics and its applications in understanding the Earth processes.

Coarse contents:

Module No. 1:

Definition and scope of geophysics; Basic principles and concepts of geophysical study; Concepts of physical properties; Basic physical properties in the study of geophysics; Physical properties of different rock formations; Introduction to major geophysical methods; Natural and artificial source geophysical methods. Ground and airborne geophysical methods; Heat flow studies; Gravitational field of the Earth, geoid-spheroid; Isostacy; Introduction to Geomagnetism and Paleo-magnetism; Introduction to seismology, concept of seismic waves and velocities and earthquakes; Geophysics and internal constitution of the Earth

Module No. 2:

Gravity Method: principles, units, gravity measurements, gravity measuring instruments. Gravity data collection, data presentation, gravity base, concept of gravity anomaly. Gravity data reduction.

Magnetic Method: Principle, units, magnetic elements, instrumentation, concept of magnetic anomaly, magnetic base, survey procedures, corrections.

Gravity and magnetic anomaly presentations, processing and interpretation, Regional and residual anomalies, concepts interpretation, applications of gravity and magnetic anomalies.

Module No. 3:

Electrical Methods: Principles, various electrical properties used in electrical methods, classification of electrical methods, SP, Resistivity and Electromagnetic Methods – theory, survey procedures, data presentation and their various applications.

Module No. 4:

Basic principles of seismic methods, Seismic reflection and refraction methods and their applications.

SGLGEP2501: Practical based on GEO-E301 (1 Credit)

1. Physical property measurement, Variations of Physical property of Earth Materials.
2. Practical problems related to gravity and magnetic anomaly patterns, qualitative interpretation.
3. Electrical anomaly patterns (SP and resistivity) and applications.

4. Seismic data interpretation.
5. Exercises on application of Isostacy.

Course outcomes:

This course aims to enable the students

1. To gain an understanding of the basic principles and practice of exploration geophysics.
2. To gain an understanding of electrical and electromagnetic, gravity and magnetic surveying and well logging.
3. Be capable of explaining the principles of seismic refraction and reflection

Prescribed and Reference Books

- An Introduction to Geophysical Exploration by Philip Kearey, Michael Brooks and Ian Hill
- Applied geophysics by W.W. Telford
- Exploration Geophysics by Kaul and Bhattachrya
- Fundamentals of Geophysics by Lowrie
- Geophysical methods in geology by G.R. Foulger and C. Peirce
- Gravity and Magnetic interpretation in Exploration Geophysics by I.V. Radhakrishna Murthy
- Gravity and Magnetic methods by B.S.R. Rao and I.V.R. Murthy
- Introduction to Geophysical prospecting by M.B. Dobrin
- Introduction to Geophysics – Lecture Notes by Jan Valenta
- Outline of Geophysical Prospecting by M.B. Ramchandra Rao.
- Outlines of Exploration Geophysics by V.L.S. Bhimasankaram

SGLGEC2502: ENGINEERING GEOLOGY
(Theory: 3 credits & Practical: 1 credits)

Pre-requisites:

Basic (10+2) knowledge of rocks and their types. Physical properties of rocks + GEO-C101 (Mineralogy) and GEO-C201, GEO-C202 & GEO-C203 (Petrology courses).

Course objectives:

1. Rocks and their types as well as their mode of formation.
2. Physical and mechanical properties of rocks.
3. Textures and structures of rocks.
4. Chemical composition of rocks.
5. Structural features of rocks affecting civil construction.
6. Geological site investigation for civil construction.

Course contents:

Module No. 1: Geology and Civil Engineering

Engineering properties of rocks, and soils and their classifications and physical characteristics of building stones, concretes and other aggregates-mineral composition, texture, structure, porosity, strength of rocks, permeability, durability, heat resistance, etc.

Module No. 2: Structural weakness of geological materials

Significance of structures in engineering geology; Concepts of stress, strain, Mohr circle and failure theories. Discontinuities in rock masses. Weathering of rocks; Mass movements with special emphasis on landslides and causes of hill slope instability. Rock slope stability, landslides and stability of structures; Engineering behaviour of rock materials and rock masses; Engineering aspects of weaker geological materials.

Module No. 3: Geological site investigation

Geological investigations in construction of dams, reservoirs, tunnels, bridges, highways and coastal protection structures; geologic considerations of construction materials.

Module No. 4: Remedial measures and Case Studies

Remedial measures for and reinforcements of weaker geological materials; Seismic design of buildings. Site investigations and important case studies.

SGLGEP2502: Practical based on GEO-E303 (1 credit)

1. Rock studies in hand specimen, rock studies in thin sections.
2. Mechanical properties of rocks (texture, structure, porosity, strength of rocks, permeability, durability, heat resistance, etc,)
3. Geological cross sections.
4. Structural problems related to borehole data; stress-strain analyses.

Course outcomes:

Students who earn minimum grade should be able to

1. Interpret the field data and interpret structures and deformations.
2. Identify rock properties (mechanical properties).
3. Understand role of structural features of rocks in engineering geology.
4. Carry out geological cross section and interpretation of subsurface geology.
5. Understand role of chemical composition of rocks in engineering geology.
6. Carry out geological site investigation for civil construction.
7. Carry out seismic zone classification and seismic design of building.
8. Understand behaviour of rocks under stress.

Prescribed and Reference Books

- A Text Book Geology by P.K. Mukharjee
- Blue Planet by Skinner and Porter
- Engineering Geology by Purbin Singh
- Engineering Geology- Principle and Practice by Price and David George
- Experiments in Engineering Geology by K.V.G.K. Gokhale and D.M. Rao
- Foundations of Engineering Geology by Waltham
- Fundamentals of Engineering Geology by F.G. Bell
- Geology for Civil Engineers by McLean and Gribble
- Handbook of Mechanical Properties of Rocks by V.S. Vutukuri, R.D. Lama and S.S. Saluja
- Introduction to the Rock Physics by G. Yves and P. Victor
- Physical Geology by Arthur Holmes
- Principle of Engineering Geology by Johnson De Graff
- Principles of Engineering Geology by D.P. Krynine and W.P. Judd
- The Earth by Press and Seiver
- The Fracture of Rocks by J.L. Bles and B. Feuga
- The Physics of Rocks by V.Q. RzLevisky and G. Novik
- The Rock Physics by M. Garg, T. Mukherjee and J. Dvorkin

Wave Propagation in Elastic solids by J.D. Achenbach

SGLGCC2551: COAL AND PETROLEUM GEOLOGY

(Theory: 4 credits & Practical: 2 credits)

Pre-requisites:

Basic (10+2) knowledge of chemistry and biology + Stratigraphy and Palaeontology.

Course objectives:

1. To understood the origin, formation and occurrence of coal.
2. To understood the origin, formation and occurrence of petroleum.
3. To study the geographical and geological distribution of coal and petroleum.
4. To study the geological and geochemical prospecting for coal and petroleum
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations / pvt. organizations
6. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.

Course contents:

Module No. 1:

Definition and origin of coal; Sedimentalogy of coal bearing strata; Types of seam discontinuities and structures associated with coal seams; Chemical analysis of coal (proximate and ultimate analysis). Coal Petrology – concept of 'Lithotype', 'Maceral' and 'Microlithotype'; Techniques and methods of coal microscopy; Classification of coal in terms of rank, grade and type.

Module No. 2:

Indian classification for coking and non-coking coals; International classifications (I.S.O. and Alpern's classification). Geographical and geological distribution of coal and lignite in the world and in India. Indian coal reserves and production of coal in India. Coal bed methane – a new energy resource. Elementary idea about generation of methane in coal beds.

Module No. 3:

Petroleum and its composition; Theories of Origin of Petroleum; Occurrence of Petroleum; Surface and sub-surface occurrences; Reservoir Rocks: Fragmental, Chemical and Miscellaneous; Marine & Non-Marine Reservoir Rocks; Introduction to pore space, fluid content, reservoir traps; Reservoir Conditions - effect of temperature & pressure.

Module No. 4:

Migration & accumulation of Petroleum; Petroleum Provinces - sedimentary basins, carbon-ratio theory, unconformities; Petroleum exploration techniques & strategies; Major Petroleum Provinces. Classification and stratigraphy of petroliferous basins of India. Oil and source rock correlation. Locating petroleum prospects based on principles of petroleum generation and migration (geological modeling). Quantitative evaluation of oil and gas prospects through geochemical modeling.

SGLGCP2551: Practical based on GEO-C401 (2 Credits)

In Laboratory:

Megascopic identification, classification and description of coal. coal seam problems; Coal mining problems; Problems related to petroleum deposits. Study of geological maps and sections of important oil fields of India. Calculation of coal reserves; Calculation of oil reserves.

In Field:

Field visit to coal mines; Collection of different coal samples; Study of coal and petroleum prospective areas.

Course outcomes:

At the completion of the course students would be able to

1. Understand the theories of origin of coal and petroleum.
2. Explain distribution of coal and petroleum in different geological environments.
3. Identify different types of coal.
4. Calculate coal and oil reserves.

Prescribed and Reference Books

- Coal and Coal-bearing strata: Recent Advances. The geological Society of London, Publication no. 32 (1987) by A.C. Scott
- Coal and organic Petrology by Singh, M.P. (Ed.)
- Elements of Petroleum Geology by R.C. Selley
- Hydrocarbon exploration and production by F. John, M. Cook and M. Graham
- Introduction of Petroleum Geology by G.D. Holson and E.N. Tiratso
- Micropaleontology in Petroleum Exploration by R.W. Jones
- Organic Petrology by G.H. Taylor, M. A. Teichmuller, Davis, C.F.K. Diesel, R. Little, and P. Robert
- Petroleum Formation and Occurrence by B.P. Tissot and D.H. Welte
- Petroleum Geochemistry and Geology by J.M. Hunt
- Petroleum Geology by F.K. North
- Textbook of Coal (Indian context) by D. Chandra, R.M. Singh and M.P. Singh
- Textbook of Coal petrology by E. Stach, M-Th. Mackowsky, G.H. Taylor, D. Chandra, M. Teichumullelr and R. Teichmuller
- Thermal Modeling of Petroleum Generation by C. Barker

SGLGCC2552: GEOEXPLORATION, MINING GEOLOGY AND MINERAL ECONOMICS
(Theory: 4 credits & Practical: 2 credits)

Pre-requisites:

Basic (10+2) knowledge of chemistry and physics + GEO-C101 (Mineralogy) + GEO-E101 (Stratigraphy) and GEO-C201, GEO-C202 & GEO-C203 (Petrology courses).

Course objectives:

1. To understood the concept and scope of geo-exploration.
2. To understood the economy of mineral resources.
3. To study the mineral dispersion and there identification.
4. To understand different mining techniques
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations / Pvt. organizations.
6. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.

Course contents:

Module No. 1:

Classification of mineral deposits for exploration. Host rocks of mineral deposits. Methods of exploration - mapping on different scales, surveying, pitting/trenching, drilling, logging, sampling - general principles and methodologies;

Module No. 2:

Geological exploration: Geological criteria and guides for exploration of mineral deposits. Gossan and capping. Structural, Lithological and Stratigraphic Guides. Geophysical exploration - gravity, magnetic, seismic and electrical methods, field procedures and interpretation of the data; Brief description and application of radioactive methods. Geochemical exploration - soil, bed rock sampling, water sampling. mobility and geochemical associations of elements. Geochemical prospecting methods. Primary and secondary geochemical dispersion patterns. Geo-botanical exploration methods.

Module No. 3:

Definition, basic concepts, terminology, broad classification of mining methods: Placer mining methods, open pit methods, Underground mining methods, Coal Mining methods and Ocean bottom mining methods; Mining of surface and underground mineral deposits Geological factors considered for the selection of mining method; Mining hazards and safety measures; Mines & Minerals Regulation & Development Act.

Module No. 4:

Mineral economics and its concepts. Peculiarities inherent in mineral industry. Tenor, grade and specification. Strategic, critical and essential minerals. Conservation and substitution. Changing pattern of mineral requirement; Importance of minerals in national economy; marine mineral resources and laws of the sea; Indian mineral policy and legislation; Mineral Concession Rules.

SGLGCC2552: Practical based on GEO-C402 (2 Credits)

In Laboratory:

Estimation of grade and ore reserves: Bedded type and vein type (Extended area and included area methods); Surveying - Plane table survey, chain survey, prismatic compass survey, abney level survey. Bore hole problems; Gravity, magnetic and electrical survey related problems and calculations. Cross section of mines with the help of available data; Preparation of mineral maps of India; Graphical representation of production, export and import of important minerals.

In Field:

Techniques of stream sampling; Magnetic and electrical surveys in the field and interpretation of data; Field report on nearest mines.

Course outcomes:

At the completion of the course students would be able to

1. Understand the different mineral exploration methods.
2. Understand different sampling and mining techniques.
3. Understand the role of minerals in global and national economy.
4. Calculate mineral reserves.
5. Interpret different exploration data sets.
6. Represent mineral data through various graphs.

Prescribed and Reference Books

- Biological Methods of Prospecting for Minerals by R.R. Brooks
- Courses in Mining Geology by R.P.N. Arogyaswami
- Economic Geology Principles and Practice: Metals, Minerals, Coal and Hydrocarbons – Introduction to Formation and Sustainable Exploitation of Mineral Deposits by Walter L. Pohl
- Elements of Geochemistry, Geochemical Exploration and Medical Geology by K.R. Randive
- Elements of Mining by G.J. Young
- Elements of Mining by R.A. Lewis and G.A. Clark
- Elements of Prospecting and Exploration by T.C. Bagchi, D.K. Sengupta and S.V.L.N. Rao
- Elements of prospecting for non-fuel mineral deposits by P.K. Banerjee and S. Ghosh
- Geobotany and Biogeochemistry in Mineral Exploration by R.R. Brooks
- Geochemical exploration methods for mineral deposits by A. A. Beus and S. V. Grigorian
- Geological Prospecting & Exploration by V. M. Kneiter
- Introduction to Mineral Exploration by A.M. Evans
- Introduction to Mining Engineering by H.L. Hartman
- Mineral Economics by R.K. Sinha and N.L. Sharma
- Mineral Economics: An Indian Perspective by Kirtikumar Randive and Sanjeevani Jawadand
- Mineral Exploration: Principles and Applications by Swapan haldar
- Mining Geology by H.E. Mckinstry
- Mining of Mineral deposits by L. Sheryanthov

- Plants for Geobotanical Prospecting: Indicator Plants Used for Sampling for Geochemical Prospecting by Donald Leslie Masson
- Principles of Geochemical Prospecting by I. I. Ginzburg
- Principles of Mine Planning by Jayanth Bhattacharya

SGLGEC2551: DISASTER MANGEMENT
(Theory: 3 credits & Practical: 1 credit)

Pre-requisites:

This course may offer specializations in areas like threat response, disaster management, disaster preparedness or public administration. These specialization degrees will require specific prerequisites. It also requires prerequisites in leadership, organizational behavior, emergency services, public administration, strategic planning, and occupational safety and health. Students will learn how to plan for disasters and emergencies while applying the common concepts of disaster management. Students will explore documented case studies in order to understand how real disaster situations interrupt operational efficiency and effectiveness.

Salient features:

The course may be learned by any students of any discipline as Disaster Management (DM) is multi disciplinary and draws its knowledge base from a range of disciplines. The overall aim of this is to provide broad understanding about the basic concepts of Disaster and its management.

Course objectives:

1. The aim of Approaches to Disaster Risk Reduction is to enhance the knowledge by providing existing models in risk reduction strategies to prevent major. causalities during disaster.
2. To promote Prevention and Preparedness plan for disaster mitigation.
3. To undertake the role of individual/volunteer in mitigation & Risk Reduction steps.
4. To prioritize Rescue and Relief operation during disaster.
5. To understand the causes, effects and remedial measures for disaster.

Module No. 1: Introduction of Disaster

Introduction of Disaster, Types/Classification of Disasters, Natural and Manmade disasters, Flood, Landslide, Earthquake, Volcanism, Cyclones, Drought, Fire, Tsunami, Mining, Wind storms, Nuclear/Biological/Chemical disasters, Environmental pollution, Global warming, Road/Rail accidents, endemic/pandemic disasters etc., Disaster potential in India.

Module No. 2: Disaster Impacts

Disaster loss, Social and economic impacts, Environmental Impacts, Reconstruction and Rehabilitation problems, Damage assessment, Hazard identification, Disaster Risk and Vulnerability, Disaster risk reduction, Risk analysis techniques, Primary and secondary impacts of disasters etc.

Module No. 3: Disaster Management and Legislation

Disaster management Act- 2005, National/State/District level disaster management, Disaster prediction, Disaster mitigation strategies, Disaster management cycle, Disaster prevention, Disaster preparedness, disaster preparedness plan for people and infrastructure, community based disaster preparedness plan, Early warning system model in disaster preparedness.

Module No. 4: Disaster Relief and Case Studies

Basic components of disaster relief (Water, Food, Sanitation, Shelter, Health, Waste management etc). Disaster mitigation, Role of International agencies, NGO's, Community based Organisations (CBO's), Role of individual, voluntary organization, Disaster monitoring and evaluation, Disaster relief fund, Disaster related case studies, The project/field work is meant for students to understand vulnerabilities and to work on reducing disaster risk, project/case studies are conceived creatively based on the geographic location and hazard profile of given region etc.

SGLGEC2551: Practical based on GEO-E401 (2 Credits)

1. Prepare a Map showing Major Disasters of India
2. Prepare a Map showing Disaster Vulnerability of India
3. Prepare a Map showing Seismic Zonation of India
4. Calculate the Distance to the Epicenter
5. Prepare a Table Showing MM Scale VS. Ritcher Scale Relationship
6. Prepare a Map showing Landslide Zonation of India
7. Prepare a Map showing Flood Zonation of India
8. Prepare a Map showing Tsunami Zonation of India
9. Prepare a Map showing Cyclone Zonation of India
10. Write Do's and Dont's Before, During and After Disaster for Earthquake Disaster, Landslide Disaster, Cyclone Disaster, Flood Disaster, Tsunami Disaster

In Field:

Field visits to earthquake, tsunami, landslide flood and avalanche vulnerable areas and visits to National laboratories involved in disaster mitigation and management.

Course outcomes:

1. It helps to learn the concept of Disaster Management and its application during on site and off site emergency.
2. The project/field work is meant for students to understand vulnerabilities and to work on reducing disaster risk, project/case studies are conceived creatively based on the geographic location and hazard profile of given region etc.
3. It may help to individual to create the ability for mitigate the disaster risk.
4. It is important to learn the Preparedness plans for disaster response.
5. It creates the ability monitoring and evaluation plan for disaster response and its functioning at national/state/district level.
6. It may helps to learners to create hazard/risk profile maps of any geographical area.

SGLGRP2551: RESEARCH PROJECT
(Thesis: 4 credits & Presentation: 2 credits)

Pre-requisites:

Completed all required credits of Theory and Practicals.

Course objectives:

1. To independently work on a scientific problem.
2. To able to generate new data OR able to synthesize and analyze available large global data sets.
3. To interpret the data and derive scientifically robust conclusions.
4. To learn software required for thesis work.
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes / govt. organizations / Pvt. organizations.
6. To develop the analytical and interpretative skills so that he/she will be competent enough to get job in this field of specialization.

Dissertation (Thesis - 4 Credits):

Every Post-graduate student has to mandatorily submit dissertation thesis. The 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. The thesis should be based on sound methodology and well defined objectives.

Presentation based on Dissertation (Thesis - 2 Credits)

Every student has to present his/her thesis in open house and defend their work.

Course outcomes:

At the completion of the course students would be able to

1. Well versed with the literature on the chosen topic.
2. Independently define a scientific problem.
3. Carry out focused study on a research topic.
4. Analyze and interpret large data sets.
5. Independently write thesis / project proposal.
6. Present and defend the scientific work.

Prescribed and Reference Books

- Disaster Management by Dr. S. R. Singh
- Disaster Management by Shailendra K. Singh, Subhash C. Kundu and Shobhue Singh Disaster Preparedness in India by Narendra Kumar Jain and Adhyatma Sadhana Kendra
- Disaster Management by H. Sarvothaman and K. J. Anandha Kumar
- Environmental Science by S. C. Santra
- Natural Disaster by R. K. Sharma and G. Sharma (2005) (ed)
- Natural Disaster Reduction by Girish K.M. and G.C.Mathur
- Natural Hazard by Bryant Edwards
- Space technology for disaster management: A remote sensing and GIS perspective, Indian institute of Remote sensing (NRSA), Dehradhun

Guidelines for Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col 6).

B. End Semester Assessment (80% of the Maximum Marks):

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

Note: **Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45lectures.**

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