Punyashlok Ahilyadevi Holkar Solapur University, Solapur



NAAC Accredited-2022 'B++'Grade (CGPA2.96)

Name of the Faculty: Science & Technology

NEP 2020

Syllabus: Geology

Name of the Course: B.Sc. II (Sem. III and IV)

(Syllabus to be implemented from June 2025)

Preamble:

The purpose of education is to develop an integrated personality of the individual and the educational system. It provides all knowledge and skills to the learner. Earth science is an important scientific discipline which involves dynamics and evolution of earth, interaction with life, oceans and the atmosphere. It also includes Earth's interior and near space environment. The present syllabus constitutes of fundamental part of earth dynamics, minerals, fossils, various structures formed in the rocks. It helps students to have knowledge of the earth, earthquakes and volcanoes, nature and effects of different types of natural stresses acting on and below the earth. A study of field geological terminology and various structures like folds, faults etc. give applied knowledge to students with respect to engineering geology, economic geology. Rocks are basic substances of the earth. Study of rocks help to understand their formation, occurrence and significance. Fossils give information of historical geological events.

The syllabus developed for Geology has the provision of ensuring the integrated personality of the students in terms of providing opportunity for exposure to the students towards Discipline Specific Courses, Generic Elective Courses, Value Enhancement Courses and Skill Enhancement Courses with specific skills through practicals and other innovative transactional modes.

Course outcomes: After completing the course, the student will be able to

- learn the genesis of the rocks
- understand the formation, characters of different rocks
- understand the characters, uses of Ores, Industrial minerals
- learn the fundamentals of Geomorphology
- learn the Concepts related with preservation modes of Fossils
- study fossils to understand paleo-climate
- measure the Geological data from the field
- make Geochemical calculations to identify types of rocks

University, Solapur Faculty of Science and Technology

Three Majors in First Year structure as per NEP-2020 Approved in For AC Meeting on 18/04/2024

4- Year Multidisciplinary UG Program with DSC as a Major (4 -Year Bachelor of Science(Honors)/(Honors with Research))

B.Sc.- II (Geology)

5.0/20 0	111	DSC1- 3 Igneous Petrology (2+1) DSC1-4 Sedimentary Petrology (2+1)	DSC2-3 Elements of Igneous Rocks (2+1) DSC-2-4 Elements of Sedimentary Rocks (2+1)	GE3 / OE3 Geomorphology (2)	VSC1 (2) Mineral and Energy Resources of India (DSC1) VSC2(2) Study of Rocks (DSC2)	L2-1 (2)	CC2 (2)	22	44 UG Diploma (88)
	IV	DSC1-5 Metamorphic Petrology (2+1)	DSC2-5 Elements of Metamorphic Rocks(2+1)	GE4/ OE4 Earth Resources (2)	VSC3 (2) Geochemical Calculations of Rocks (DSC1)	L2 - 2(2)	FP1/CEP1(2)	22	
Exit opt	ion: A	Paleontology (2+1) ward of UG Diploma in	Elements of Fossils (2+1) Major with 88 credits	s and an additional	VSC4(2) Physical and Structural Geology (DSC2)	course/ In	ternship OR C	Continue	with Major

Structure as per NEP-2020

B. Sc. II (Geology)

Level	Sem	Мај	jor	Min	or	VSC/	OE/GE	AEC	CC	Total Credit	Cumulativ
		Т	Ρ	Т	Ρ	320				S	Credits
		2	1	2	1	OE-3	VSC1 (2)	L2- 1 (2)	CC2-2	22	
	III	2	1	2	1	/GE-3	(DSC1)				
						(2)	VSC2 (2)				
5.0		2	1	2	1	OE-4	VSC 3	L2-2 (2)	FP1/	22	44
	IV	2	1	2	1	/GE-4	(DSC1)		CEP1		
		~		2	'	(2)	VSC4				
0.11		<u> </u>	<u> </u>			(2)	(0002)				
S.NO.	code	Тур	e wi	th co	ourse	Paper IIt	le				Credit
1.	Major D	SC1	-3			Geology-I	III (Igneous Pe	trology)			2
2.	Practica	al bas	ed o	n DS(C1-3	Practical I	Lab				1
3.	Major D	SC1	-4			Geology-	IV (Sedimenta	ary Petrology)			2
4.	Practica	al bas	ed o	n DS(C1-4	Practical I	Lab				1
5	Minor [DSC2	2-3			Elements	of Rocks -I (Ig	neous Rocks)			2
6.	Practica	al bas	ed o	n DS(C2-3	Practical I	Lab				1
7	Minor [DSC2	2-4			Elements	of Rocks - II (S	Sedimentary R	ocks)		2
8	Practica	al bas	sed or	n DS(C2-4	Practical I	Lab				1
9	GE-3/OE-3 Geomorphology				2						
10	VSC1					VSC base	ed on DSC maj	or			2
	1/000				Mineral and Energy Resources of India						
11	VSC2 VSC based on DSC major				2						
10	450.11	<u> </u>				Mineralo	gy and Crysta	llography			
12	AECTL	.2-1				000					2
13	UU2 (2))									2
1.4	Major D	NC1	5			Coology	/ (Motomorph				22
14			-0 0 0 0	<u>, DS(</u>	71 5	Brootical		ic Petrology)			2
15	Major D		6-6	1030	51-5	Geology	VI (Paleontol	001/)			1
10					21-6	Bractical		ogy)			2
17	Minor	1 Das	-5	1030	51-0	Flomente	of Rocks-III (N	letamorphic R	ncke)		2
10	Practica	al has	ed o		22-5	Practical	lah		JURSJ		1
20	Minor D	SC2	-6		52 0	Study of	Fossils				2
20	Practica	albas		n DS(22-6	Practical	lah				1
22	GE-4/ C)E-4			52 0	Earth Res	sources				2
	02 ./ 0										-
23	VSC3			VSC base Geochem	ed on DSC maj nical Calculati	or -5 ons of Rocks			2		
24	VSC4					VSC base	ed on DSC maj	or -6			2
						Physical	and Structura	al Geology			
25	AEC II										2
26	FP1/CE	P1				FP1/CEP	1				2
						Total					22
					Grand To	otal				44	

11111Semester – I

	B.Sc II Semester - I	11			
Course Code	Title of Papers	Dist N Ex	tribution farks fo aminati UA	n of or on Total	Total credit
DSC1-3 (2)	Igmeous Petrology	20	30	50	2
PR DSC1-3 (1)	Practical based on DSC1	20	30	50	1
DSC1-4 (2)	General and Physical Geology	20	30	50	2
PR DSC1-4 (1)	Practical based on DSC1	20	30	50	1
Minor DSC2 -3	Elements of Rocks -I (Igneous Rocks)	20	30	50	2
Practical based on DSC2-3	Elements of Rocks -I (Igneous Rocks)	20	30	50	1
Minor DSC2 -4	Elements of Rocks -I (Sedimentary Rocks)	20	30	50	2
Practical based on DSC2-4	Elements of Rocks -I (Sedimentary Rocks)	20	30	50	1
GE-3/OE-3	Geomorphology	20	30	50	2
VSC1	VSC based on DSC major (Mineral and Energy Resources of India)	20	30	50	2
VSC2	VSC based on DSC major (Mineralogy and Crystallography)	20	30	50	2
AEC L2-1		20	30	50	2
CC2 (2)	CC2	20	30	50	2
	Marks + Credit for Semester – I	260	390	650	22
	Semester –IV				
Course Code	Title of Papers	Di Ex	stributio Marks f aminati	on of For on	Total credit
		CA	UA	Total	
Major DSC1 -5	Geology-V (Metamorphic Petrology)	20	30	50	2
Practical based on DSC1 -5	Practical Lab	20	30	50	1
Major DSC1-6	Geology –VI (Paleontology)	20	30	50	2
Practical based on DSC1-6	Practical Lab	20	30	50	1
Minor DSC2-5	Study of Rocks-III (Metamorphic Rocks)	20	30	50	2
Practical based on DSC2-5	Practical Lab	20	30	50	1

Minor DSC2-6	Study of Fossils	20	30	50	2
Practical based on DSC2-6	Practical Lab	20	30	50	1
GE-4/ OE-4	Earth Resources	20	30	50	2
VSC3	VSC based on DSC major -5 Geochemical Calculations of Rocks	20	30	50	2
VSC4	VSC based on DSC major -6 Physical and Structural Geology	20	30	50	2
AEC II		20	30	50	2
FP1/CEP1	FP1/CEP1	20	30	50	2
	Marks + Credit for Semester – I	260	390	650	22
Total Mar	rks + Credit for Semester - I	260	390	650	22
Total Ma	urks + Credit for Semester - II	260	390	650	22
	Total Marks and Credit	520	780	1300	44

Semester – I

SEM -III

DSC 1-3 (Theory) Title of the Paper – Igneous Petrology

Unit:1

Objective: To get knowledge about Magmatic material
Outcome: The students can understand Magmatic material their origin, composition and types.
Objective: To get knowledge about classification of Igneous rock
Outcome: The students can understand about classification of igneous rock based on mode of occurrence, silica Saturation and silica percentage
Objective: To get knowledge about textures and structures
Outcome: Students will understand the definitions of textures and structures

Unit2.

Objective: To get knowledge about types of textures in igneous rock
Outcome: Students will understand the difference textures
Objective: To get knowledge about types of structures in igneous rock
Outcome: Students will understand the difference structures
Objective: To get knowledge about forms of igneous rock
Outcome: The students can understand structure, concordant and discordant forms
Objective: To get knowledge about detailed petrographic description of rocks
Outcome: Students will understand detailed petrographic description of rocks

Credits: 02	Total Marks: 50	Theory: 30 Periods
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Unit No.	Title of topic and contents	Contact Hours
Ι	Definition of rock, types of rocks and rock cycle. Magma and lava- definition, composition, types and origin. Definition of Igneous rock. Classification of igneous rocks based on: 1) mode of occurrence, 2) silica	15
	 Definition of textures and structures of igneous rocks: Description of textures: 1) crystallinity, 2) granularity, 3) shape of crystal and 4) mutual relations of crystals and glassy matter. Differentiation: liquid immiscibility, gravitational and filtration. Role of volatiles in differentiation. Reaction relationship - Bowen's reaction series. Crystallization of unicomponent (augite), bicomponent [two independent - (diopside - anorthite) and mix-crystals - albite - anorthite system)] and ternary magma (diopside - albite - anorthite system). 	
Π	Textures of igneous rocks: 1) Granitic, 2) porphyritic, 3) Ophitic, 4) sub- ophitic, 5) Poikilitic, 6) Intergranular, 7) Intersertal, 8) glassy Structures of igneous rocks: 1) Vesicular and amygdaloidal, 2) ropy, 3) flow, 4) pillow, 5) columnar. Forms of igneous rocks - concordant and discordant forms; Detailed petrographic description of granite, pegmatite, granodiorite, rhyolite, quanita diorite, grabbro headt and dolorite.	15

DSC 1-3 (Practical) – Igneous Petrology

	Credits: 01 Total Marks: 50 Practical: 30 Perio	ods
Unit No.	Title of topic and contents	Contact Hours
Ι	 Megascopic and microscopic identification and description of igneous rocks. 1. Megascopic: granite, porphyritic granite, graphic granite, pegmatite, rhyolite, syenite, gabbro, dolerite, basalt, pitchstone / obsidian and dunite. 2. Microscopic: granite, graphic granite, rhyolite, syenite, gabbro, dolerite, basalt and dunite. 	02/week
II	 Megascopic and microscopic identification and description of textures and structures of igneous rocks. 1. Megascopic: granitic, porphyritic, graphic, glassy, flow, vesicular and amygdaloidal, columnar and pillow. 2. Microscopic: granitic, porphyritic, graphic, glassy and ophitic. 	02/week

Text Books/ Reference Books:

Igneous & Metamorphic petrology. Turner, F.J. & Verhoogen, J., McGraw Hill Co.

2. Igneous petrology. Bose, M.K., World press

3. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

4. Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS

Publishers

5. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

DSC 1-4 (Theory) Title of the Paper – Sedimentary Petrology

Unit:1

Objective: To get knowledge about sedimentation process

Outcome: The students can understand process of sedimentary rock formation including lithification and digenesis

Objective: To get knowledge about classification of sedimentary rock

Outcome: The students can understand about classification of i sedimentary rock based on mineral composition, Texture and formation

Unit2.

Objective: To get knowledge about textures and structures

Outcome: Students will understand the definitions of textures and structures

Objective: To get knowledge about types of textures in sedimentary rock

Outcome: Students will understand the difference textures

Objective: To get knowledge about types of structures in sedimentary rock

Outcome: Students will understand the difference structures

Objective: To get knowledge about detailed petrographic description of rocks

Outcome: Students will understand detailed petrographic description of different rocks

Credit	s: 02 Total Marks: 50 Theory: 30 Periods	
Unit No.	Title of topic and contents	Contact Hours
I	 Sedimentary petrology: definition, processes of formation – lithification and digenesis. Classification of sedimentary rocks: 1. Based on products of weathering – Residual, sedimentary, chemical and organic deposits 2. Based on mineralogy – a) siliciclastic, b) carbonates (Limestone and dolomite), c) non carbonates - ironstones and banded iron formations (limonite, goethite and hematite and d) phosphorites, evaporites (rock salt, gypsum) and e) organic-rich (carbonaceous) deposits (coal) and 3. Based on size and shape of the grains. 	15
II	 Sedimentary rock textures and structures A. Textures of sedimentary rocks – clastic, oolitic and pisolitic B. Structures of sedimentary rocks – stratification, lamination, graded bedding, current bedding, Mud cracks and ripple marks. Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, sandstone, Arkose, Grit, shale, Mudstone and limestones. Residual rocks – laterite and bauxite 	15

DSC 1-4 (Practical) – Sedimentary Petrology

Credits:	01
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Total Marks: 50

Practical: 30 Periods

Unit	Title of topic and contents			
No.		Hours		
т	Megascopic and microscopic identification and description of sedimentary rocks.	02/ 1		
1	1. Megascopic: conglomerate, breccia, sandstone, ferruginous sandstone, shale, arkose, grit, limestone, fossiliferous limestone, laterite and bauxite.	02/week		
	2. Microscopic: sandstone, arkose, limestone, oolitic limestone and fossiliferous limestone.			
II	Megascopic and microscopic identification and description of textures and structures of sedimentary rocks.			
	1. Megascopic: clastic, stratification, lamination, cross bedding, graded bedding, ripple marks and mud cracks.	02/week		
	2. Microscopic: clastic, oolitic and pisolitic			

Text/ Reference Books:

1. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

2. Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS Publishers

3. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

4. Principles of Sedimentology. Friedman & Sanders, John Wiley and sons.

5. Sedimentary rocks. Pettijohn, F.J., Harper & Bros. 3rd Ed.

6. A text book of sedimentology. Prasad, C.,

7. Introduction to sedimentology. Sengupta. S., Oxford-IBH.

DSC2 -3 (Minor- Theory)

Title of the paper – Elements of Igneous Rocks

Unit:1

Objective: To get knowledge about Magma and Lava

Outcome: The students can understand magma and Lava with their origin, composition and types.

Objective: To get knowledge about classification of Igneous rock

Outcome: The students can understand about classification of igneous rock based on mode of occurrence and silica percentage

Objective: To get knowledge about textures and structures

Outcome: Students will understand the meaning of textures and structures

Objective: To get knowledge about forms of igneous rock

Outcome: The students can understand structure, concordant and discordant forms

Unit2.

Objective: To get knowledge about types of textures in igneous rock

Outcome: Students will understand the difference textures

Objective: To get knowledge about types of structures in igneous rock

Outcome: Students will understand the difference structures

Objective: To get knowledge about detailed petrographic description of rocks

Outcome: Students will understand detailed petrographic description of rocks

C	edit: 02 Total Marks: 50 Practica	l: 30 Periods
Unit No.	Title of topic and contents	Contact Hours
Ι	Definition of Rock, Types and Rock cycle. Magma and lava- definition, types. Definition of Igneous rock. Classification of igneous rocks based on Mode occurrence, Silica percentage Forms of igneous rocks: concordant and discordant forms	e of 15
II	Textures of igneous rocks: 1) Granitic, 2) porphyritic, 3) Ophitic, 4) Graphic glassy Structures of igneous rocks: 1) Vesicular and amygdaloidal, 2) ropy, 3) flow pillow, 5) columnar. Detailed petrographic description of granite, pegmatite, granodiorite, rhyo	2 5) (, 4) 15 lite,

DSC 2-3 (Minor -Practical) – Elements of Igneous Rocks

Credits: 01

Total Marks: 50

Practical: 30 Periods

Unit No.	Title of topic and contents	Contact Hours
Ι	 Megascopic identification and description of igneous rocks with Geological occurrence. 1. Megascopic: granite, porphyritic granite, graphic granite, pegmatite, rhyolite, syenite, gabbro, dolerite, basalt, pitchstone / obsidian and dunite. 	02/week
II	Megascopic identification and description of textures and structures of igneous rocks. 1. Megascopic: granitic, porphyritic, graphic, glassy, flow, vesicular and amygdaloidal, columnar and pillow.	02/week

Text Books:

Igneous & Metamorphic petrology. Turner, F.J. & Verhoogen, J., McGraw Hill Co.

2. Igneous petrology. Bose, M.K., World press

3. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

 Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS Publishers

5. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

DSC 2-4 (Minor -Theory)

Title of the Paper – Elements of Sedimentary Rocks

Unit:1

Objective: To get knowledge about sedimentation process **Outcome**: The students can understand process of sedimentary rock formation **Objective**: To get knowledge about classification of sedimentary rock **Outcome**: The students can understand about classification of i sedimentary rock based on Texture and formation

Unit2.

Objective: To get knowledge about textures and structures Outcome: Students will understand the definitions of textures and structures Objective: To get knowledge about types of textures in sedimentary rock Outcome: Students will understand the difference textures with genesis Objective: To get knowledge about types of structures in sedimentary rock Outcome: Students will understand the difference structures with genesis Objective: To get knowledge about detailed petrographic description of rocks Outcome: Students will understand detailed petrographic description of different rocks

Credit	s: 02 Total Marks: 50 Theory: 30 Periods	
Unit No.	Title of topic and contents	Contact Hours
Ι	 Sedimentary rocks: definition, processes of formation. Classification of sedimentary rocks: 1. Based on products of weathering – Residual, sedimentary, chemical and organic deposits 2. Based on size and shape of the grains. 	15
Π	 Sedimentary rock textures and structures A. Textures of sedimentary rocks – clastic, oolitic and pisolitic B. Structures of sedimentary rocks – stratification, lamination, graded bedding, current bedding, Mud cracks and ripple marks. Petrographic details of important rocks such as - conglomerate, breccia, sandstone, Arkose, Grit, shale, Mudstone and limestones. Residual rocks – laterite and bauxite 	15

DSC 2-4 (Practical) – Elements of Sedimentary Rocks

Credits: 01

Total Marks: 50

Practical: 30 Periods

Unit No.	Title of topic and contents	
Ι	 Megascopic and microscopic identification and description of sedimentary rocks. 1. Megascopic: conglomerate, breccia, sandstone, ferruginous sandstone, shale, arkose, grit, limestone, fossiliferous limestone, laterite and bauxite. 2. Microscopic: sandstone, arkose, limestone, oolitic limestone and fossiliferous limestone. 	02/week
II	 Megascopic and microscopic identification and description of textures and structures of sedimentary rocks. 1. Megascopic: clastic, stratification, lamination, cross bedding, graded bedding, ripple marks and mud cracks. 2. Microscopic: clastic, oolitic and pisolitic 	02/week

Text/ Reference Books:

1. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

2. Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS Publishers

3. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

4. Principles of Sedimentology. Friedman & Sanders, John Wiley and sons.

5. Sedimentary rocks. Pettijohn, F.J., Harper & Bros. 3rd Ed.

6. A text book of sedimentology. Prasad, C.,

7. Introduction to sedimentology. Sengupta. S., Oxford-IBH.

Open Elective (OE - 3 Theory)

Title of the Paper – Geomorphology

Unit:1

Objective: To understand basic concept of Geomorphology **Outcome**: The students can understand principles, concept of Geomorphology **Objective**: To get knowledge about Exogeneous and Endogenous processes Outcome: The students can acquire knowledge about different earth processes **Objective**: To understand Geological work of different agents Outcome: The students understand formation of different features by different geological agents

Unit₂.

Objective: To get knowledge about continental drift Outcome: Students will understand the about concept of continental drift **Objective**: To get knowledge about Palaeomagnetism Outcome: Students will understand the knowledge of Palaeomagnetism **Objective**: To get knowledge about Plate tectonics Outcome: Students will understand about Plates and other concept of Plate tectonics

Credit	s: 02 Total Marks: 50 Theory: 30 Period	s
Unit No.	Title of topic and contents	Contact Hours
I	Definition and basic principles of Geomorphology Exogenic processes: degradation and aggradation. Endogenic processes; Diastrophism and volcanism Extraterrestrial processes; Geological work of wind, glacier, river, underground water, and ocean Concept of Rejuvenation	15
II	Earth as a dynamic system. Elementary idea of continental drift, sea-floor spreading, and mid-oceanic ridges. Paleomagnetism and its application. Plate Tectonics: Concept, plate margins	15

Text books/ Reference books:

- 1. Allen, P., 1997. Earth Surface Processes. Blackwell
- Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition).
- 3.. Keary, P. and Vine, F.J., 1997. Global Tectonics. Blackwell and crustal evolution
- 4. Kale, V.S. and Gupta, A., 2001. Introduction to Geomorphology. Orient Longman Ltd.
- 5. Moores, E and Twiss. R.J., 1995. Tectonics. Freeman.
- 6. Patwardhan, A. M., 1999. The Dynamic Earth System. Prentice Hall.
- 7. Summerfied, M.A., 2000. Geomorphology and Global tectonic. Springer Verlag.
- 8. Valdia, K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.
- 9. WD Thornbury, 2002. Principles of Geomorphology. CBS Publ. New Delhi.

Vocational Skill Enhancement Course (VSC- 1) (Practical) Mineral and Energy Resources of India

Unit - I

Objective: To provide knowledge about the different ore deposits

Outcome: The students get basic knowledge of different ores

Objective: To understand different properties of ores

Outcome: The students understand physical properties, chemical composition of ores

Objective: To provide information regarding coal deposits

Outcome: The students get about physical, chemical properties, geological and geographic distribution of coal

Unit -2

Objective: To provide knowledge about the different deposits of industrial minerals

Outcome: The students get basic knowledge of different industrial minerals

Objective: To understand different properties of industrial minerals

Outcome: The students understand physical properties, chemical composition of industrial minerals

Objective: To understand geographic distribution of industrial minerals

Outcome: The students study physical, chemical properties, geological and geographic distribution of industrial minerals

Objective: To provide information regarding petroleum deposits

Outcome: The students get about geological and geographic distribution of petroleum

	Credits: 02 Total Marks: 50 Practical: 60 Period	ds
Unit No.	Title of topic and contents I	Contact Hours
Ι	Study of Ore minerals with their physical properties, Chemical composition, uses, genesis, Geological occurrence in India – Hematite, Magnetite, Limonite, Pyrite, Pyrolusite, Psilomelane, Chalcopyrite, Malachite, Azurite, Galena, Zinc, Sphalerite, Bauxite, Ilmenite	04/week
	Chemical composition, genesis, Geological occurrence	
II	Study of Industrial minerals with their physical properties, Chemical composition, uses, Geological occurrence in India – Quartz, Calcite, Varieties of Feldspar, Varieties of Mica, Gypsum, Sulphur, Garnet, Corundum, Clay,	
	Asbestos, Barite Description and Preparation of Distribution map showing Petroleum deposits in India with Geological occurrence	04/week

Text/ Reference Books:

- 1. Economic Geology: Economic Mineral Deposits U. Prasad, CBS Publishers and Distributors
- 2. India's Mineral Resources S. Krishnaswamy, Oxford and IBH
- 3. Minerals and Allied Natural Resources and Their Sustainable Development: Principles,
- 4. Perspective with Emphasis on the India Scenario Mihir Deb and S.C. Sarkar, Springer
- 5. Non-Conventional Energy Resources B.H. Khan, Tata McGraw-Hill
- 6. Non-conventional Energy Resources N.K. Bansal, Vikas
- 7. World Petroleum Resources and Reserves Joseph Riva, Routledge
- 8. Mineral Economics: An Indian Perspective K. Randive and S. Jawadand, Nova Scientific Series
- 9. Mineral Resources of India D.K. Banerjee, World Press Pvt. Ltd.
- 10. Non-conventional Energy Resources S.N. Singh, Pearson
- 11. The Indian Ocean: Exploitable Mineral and Petroleum Resources G.S. Roonwal, Springer

Vocational Skill Enhancement Course (VSC- 2) (Practical) Mineralogy and Crystallography

Unit - I

Objective: To give basic knowledge about the minerals

Outcome: The students get basic knowledge about minerals and their properties

Objective: To understand different minerals

Outcome: The students understand physical properties of minerals

Unit -2

Objective: To understand concept of crystal, crystallography

Outcome: The students understand about crystal, different terminology related with crystals

Objective: To understand about crystallographic axes, different forms

Outcome: The students study different crystal systems, their elements of symmetry, forms, Indices

(Credits: 02 Total Marks: 50 Practical: 60 Per	riods
Unit	Title of topic and contents	Contact
No.		Hours
Ι	Mineralogy – Definition of Minerals, Study of different physical properties of minerals viz. color, streak, luster & types, fractur & types, Hardness and Cleavage Study of different minerals with their physical properties, chemical composition, uses – Quartz & varieties, Feldspar & varieties, Mica & varieties, Hornblende, Asbestos, Augite, Garnet, Calcite, Gypsum, Corundum, Talc, Clay, Kyanite, Zeolite & varieties, Beryl Barite, Tourmaline	04/week
II	Crystallography – Definition of Crystal, Faces, Edges, Solid angles, Crystallographic axes and their types according to crystal systems Elements of Symmetry – Planes, Axes, Centre Study of crystal systems – Cubic, Tetragonal, Orthorhombic, Monoclinic, Triclinic, Hexagonal with Mineral type, Crystallographic Axes, different forms, their faces, indices with the help of wooden models	04/week

Text/ Reference Books:

1. Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).

2. Flint, Y., 1975. Essential of crystallography, Mir Publishers.

3. Phillips, F.C., 1963. An introduction to crystallography. Wiley, New York.

4. Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.

5. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.

6. Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.

7. Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.

8. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. Mc Graw Hill, New York.

(CC2)

Title of the paper: CC -2

Credit: 02

Total Marks: 50

Theory: 30 Periods

NCC/NSS/Sports/Cultural/MOOCS/SWAYAM/YOGA/Health and Wellness

SEM -IV

DSC 1-5 (Theory) Title of the Paper – Metamorphic Petrology

Unit:1

Objective: To get knowledge about metamorphism
Outcome: The students can understand process of metamorphism and formation of metamorphic rocks
Objective: To get knowledge about different processes of metamorphism
Outcome: The students can understand about zones, grades and types of metamorphism
Objective: To get knowledge about classification of metamorphic rocks
Outcome: Students will understand different fabric types, types of stresses and minerals

Unit2.

Objective: To get knowledge about types of structure of metamorphic rocks
Outcome: Students will understand formation and characters of metamorphic structures
Objective: To get knowledge about variety of metamorphic facies
Outcome: Students will understand the formation, mineral assemblages in metamorphic facies
Objective: To get knowledge about detailed petrographic description of rocks
Outcome: Students will understand detailed petrographic description of rocks

Credits: 02	Total Marks: 50	Theory: 30 Periods
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Unit No.	Title of topic and contents	Contact Hours
	Metamorphic petrology: definition and agents of metamorphism.	
Ι	Zones and grades of metamorphism, Prograde, retrograde and Poly- metamorphism, Anataxis	15
	Type of metamorphism – contact, regional, cataclastic, hydrothermal – with examples.	
	Classification of metamorphic rocks depending upon fabric	
	stress and anti-stress minerals.	
II	Structures of metamorphic rocks – granulose, slaty, schistose, gneissose and augen.	15
	Introduction to metamorphic facies: zeolite, hornfels, blue schist, green schist, amphibolite, granulite and eclogite	10
	Petrographic details of some important metamorphic rocks such as - slate, schists, gneiss, quartzite, marble and phyllite	

DSC 1-5 (Practical) – Metamorphic Petrology

Credits: 01

Total Marks: 50

Practical: 30 Periods

Unit	Title of topic and contents	Contact
No.		Hours
Ι	Megascopic identification and description of Metamorphic rocks. 1. Megascopic: Marble, Slate, Phyllite, Quartzite, types of Schists, types of Gneiss 2. Microscopic: Marble. Quartzite, types of Schists, types of Gneiss	02/week
II	Megascopic and microscopic identification and description of textures and structures of Metamorphic rocks. 1. Megascopic: Granulose, Schistose, Slaty, Gneissose, Augen 2. Microscopic: Granulose, Schistose, Gneissose	02/week

Text/ Reference Books:

1. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

2. Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS Publishers

3. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

4. Principles of Sedimentology. Friedman & Sanders, John Wiley and sons.

5. Sedimentary rocks. Pettijohn, F.J., Harper & Bros. 3rd Ed.

6. A text book of sedimentology. Prasad, C.,

7. Introduction to sedimentology. Sengupta. S., Oxford-IBH.

DSC 1-6 (Theory) Title of the Paper – Paleontology

Unit:1

Objective: To understand elements of fossils

Outcome: The students can understand definition and conditions of preservation of fossils

Objective: To get knowledge of different modes of preservation of fossils

Outcome: The students get knowledge about modes of preservation of fossils

Objective: To understand about geological significance of fossils

Outcome: The students can understand different uses of fossils

Unit:2

Objective: To understand morphology, geological range of fossils belonging to different phylum
 Outcome: The students can understand morphology, geological range of fossils belonging to different phylum
 Objective: To understand characters of ancient horse and evolution history

Outcome: The students can understand characters of ancient horse and evolution history

Credit	s: 02 Total Marks: 50 Theory: 30 Periods	
Unit No.	Title of topic and contents	Contact Hours
	Definition of Palaeontology, Fossils	
Ι	Characters, binomial nomenclature in taxonomy, modes of preservation of fossils, condition of fossilization and significance of fossils.	
	Morphology of hard parts and geological distribution of:	15
	Brachiopoda – Spirifer, Productus, and Terebratula	15
	Lamellibranchia - Cardita, Cardium, and Pectene	
	Cephalopoda - Nautilus and Goniatites	
	Morphology of hard parts and geological distribution of:	
II	Trilobite: Ogygia, Paradoxide, and Trinucleus	15
	Echinoidea - Echinus, Micraster, and Hemiaster	
	Gastropoda - Conus, Turritella, Voluta, and Physa	
	Coelenterata - Tubipora and Favisite	
	Evolutionary history of Horse	

DSC 1-6 (Practical) – Paleontology

Credits: 01

Total Marks: 50

Practical: 30 Periods

Sr	Practical Title	Contact
No.		Hours
1	Introduction, Different modes of formation of fossils	
2	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Brachiopoda – Spirifer, Productus, and Terebratula	
3	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Lamellibranchia - Cardita, Cardium, and Pectene	
4	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Gastropoda - Conus, Turritella, Voluta, and Physa	2 Hrs/
5	Study of morphological characters of hard parts with geological range	week
	of different fossils of	week
	Class Trilobite: Ogygia, Paradoxide, and Trinucleus	
6	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Echinoidea - Echinus, Micraster, and Hemiaster	
7	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Coelenterata - Tubipora and Favisite	
8	Study of morphological characters of hard parts with geological range	
	of different fossils of	
	Class Cephalopoda - Nautilus and Goniatites	

Books Recommended:

- 1. Geology of India. Wadia, D., Mc Graw Hill Book co.
- 2. Geology of India and Burma, 6th Edition. Krishnan, M.S., CBS Publ.
- 3. Principles of Invertebrate Paleontology. Shrock, R.R. & Twenhoffel, W.H., CBS Publ.
- 4. Outlines of Paleontology. Swinerton, HH., Edward Arnold Publishers
- 5. Paleontology: Evolution & Animal Distribution. Jain, P.C. Vishal Publications.
- 6. Organic evolution. Rastogi, Kedarnath and Ramnath Publ.
- 7. Palaeontology Invertebrate. Woods, Henry. CBS Publishers & Distributors

DSC 2-5 (Minor -Theory)

Title of the Paper – Elements of Metamorphic Rocks

Unit:1

Objective: To get knowledge about metamorphism processOutcome: The students can understand process of metamorphismObjective: To get knowledge about agents, kind of metamorphismOutcome: The students can understand about different types of agents involved in metamorphism

Unit2.

Objective: To understand various metamorphic structures **Outcome**: Students will understand characters and formation of metamorphic structures **Objective**: To get knowledge about detailed petrography of metamorphic rocks **Outcome**: Students will understand detailed properties of metamorphic rocks

Credits: 02 To	tal Marks: 50	Practical: 30 Periods
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Unit	Title of topic and contents	Contact
No.		Hours
	Definition of Metamorphic rocks, Metamorphic petrology	
Ι	Agents of metamorphism, Zones and grades of metamorphism	15
	Type of metamorphism – contact, regional, cataclastic, hydrothermal – with examples.	
	stress and anti-stress minerals.	
II	Structures of metamorphic rocks – granulose, slaty, schistose, gneissose and augen.	15
	Petrographic details of some important metamorphic rocks such as - slate, schists, gneiss, quartzite, marble and phyllite	

Text/ Reference Books:

1. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).

2. Petrology, Igneous, Sedimentary and Metamorphic rocks. Ehlers, WG, and Blatt, H., CBS Publishers

3. The study of rocks in thin sections. Moorhouse, WW., Harper and sons.

4. Principles of Sedimentology. Friedman & Sanders, John Wiley and sons.

5. Sedimentary rocks. Pettijohn, F.J., Harper & Bros. 3rd Ed.

6. A text book of sedimentology. Prasad, C.,

7. Introduction to sedimentology. Sengupta. S., Oxford-IBH.

DSC2 -6 (Minor- Theory)

Title of the paper – Elements of Fossils

Unit:1

Objective: To understand elements of fossils

Outcome: The students can understand definition and conditions of preservation of fossils

Objective: To get knowledge of different modes of preservation of fossils

Outcome: The students get knowledge about modes of preservation of fossils

Objective: To understand about geological significance of fossils

Outcome: The students can understand different uses of fossils

Unit:2

Objective: To understand morphology of fossils belonging to different phylum

Outcome: The students can understand morphology of fossils belonging to different phylum

Objective: To understand characters of ancient horse and evolution history

Outcome: The students can understand characters of ancient horse and evolution history

C	Credit: 02	Total	Marks: 50		Practical: 30	Periods
Unit No.		Title of to	pic and conter	nts		Contact Hours
Ι	Palaeontology: det Characters, binom fossils, condition o	finition, Fossils: ial nomenclature of fossilization a	definition, e in taxonomy nd significanc	, modes of p e of fossils.	reservation of	15
Π	Classification, Lamellibranchia, Coelenterata Study of Gondwar	Morphologica Cephalopoda, na fossils, Study	I characte Trilobite, I of Evolution of	rs of Echinoidea, of Horse	Brachiopoda, Gastropoda,	15

DSC 2-6 (Minor -Practical) – Elements of Fossils

Credits: 01

Total Marks: 50

Practical: 30 Periods

Unit	Title of topic and contents	
No.		Hours
Ι	Study of morphological characters of hard parts with geological range of different fossils of Class Brachiopoda – Spirifer, Productus, and Terebratula	02/week
	Class Lamellibranchia - Cardita, Cardium, and Pectene Class Gastropoda - Conus, Turritella, Voluta, and Physa	
II	Study of morphological characters of hard parts with geological range of different fossils of	
	Class Trilobite - Ogygia, Paradoxide, and Trinucleus	
	Class Echinoidea - Echinus, Micraster, and Hemiaster Class Coelenterata - Tubipora and Favisite	02/week
	Class Cephalopoda - Nautilus and Goniatites	

Books Recommended:

1. Geology of India. Wadia, D., Mc Graw Hill Book co.

2. Geology of India and Burma, 6th Edition. Krishnan, M.S., CBS Publ.

3. Principles of Invertebrate Paleontology. Shrock, R.R. & Twenhoffel, W.H., CBS Publ.

4. Outlines of Paleontology. Swinerton, HH., Edward Arnold Publishers

5. Paleontology: Evolution & Animal Distribution. Jain, P.C. Vishal Publications.

6. Organic evolution. Rastogi, Kedarnath and Ramnath Publ.

7. Palaeontology Invertebrate. Woods, Henry. CBS Publishers & Distributors

Open Elective (OE - 4 Theory)

Title of the Paper – Earth Resources

Unit:1

Objective: To understand the concept of earth resources

Outcome: Students understand fundamental of earth resources

Objectives: To get knowledge about Ore minerals, genesis, and occurrences, knowledge of energy resources and its different types; groundwater resources and its management.

Outcome: Students acquire knowledge about Ore minerals, energy resources and groundwater resources and its management

Unit2.

Objective: To understand about Groundwater resources

Outcome: Students understand fundamental of Groundwater resources

Objectives: To get Rainwater harvesting

Outcome: Students acquire knowledge about Rainwater harvesting

Credits: 02

Total Marks: 50

Theory: 60 Periods

Unit No.	Title of topic and contents	
I	Earth Resources: Definition: Mineral, Ore and Gangue, Tenor, Grade. Introduction to Essential, Critical and Strategic Minerals. A brief overview of the Classification of Mineral deposits concerning processes of formation and mode of occurrences. Definition of Energy: Primary and Secondary Energy. Renewable and Non-Renewable Sources of Energy. Environmental Dimension of Energy Resources of Natural Oil and Gas. Coal and Nuclear Minerals: Types and distribution.	30
II	Groundwater resources and their management, Groundwater resources and their role in the economic development of a country. Rainwater harvesting and artificial recharge to groundwater. Watershed management.	30

Reference Books:

1. Earth Resources and Environmental Issues by Sinha A K and Shrivastav P. ABD

Publication

2. Energy and the Environment by Fowler, J.M. (1984). McGraw-Hill Global Energy Perspectives by

Nebojsa Nakicenovic 1998, Cambridge University Press.

3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh

and M.A. Prelas. 2009, Springer

4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.

5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

Vocational Skill Enhancement Course (VSC- 3) (Practical) Geochemical Calculations of Rocks

Unit - I

Objective: To give knowledge about Geochemistry of the rocks

Outcome: The students get basic knowledge about chemical analysis of rocks

Objective: To understand different methods of Calculations of Geochemical data of rocks

Outcome: The students understand different methods of Geochemical calculation methods viz. Niggli,

Norm, ACF, AKF etc.

Objective: To classify the rocks based on chemical composition

Outcome: The students can able to classify the rocks based on chemical composition

Credits: 02 Total Marks: 50 Practical: 60 Periods

Unit No.	Title of topic and contents	Contact Hours
Ι	Petrochemical calculations from given chemical analysis of rocks. Determination of CIPW Norms (Over saturated rocks) and classification, Determination of Niggli values up to quartz Values and classification Determination of ACF and plotting on triangular diagrams (compare with standard diagram from Winkler)	04/week

Text/ Reference Books:

- 1. Principles of Petrology. Tyrell, G. W., Methuren and Co (Students ed.).
- 2. Hoefs, J., 1980. Stable Isotope Geochemistry. Springer-Verlag.
- 3 . Klein, C. and Hurlbut, C.S., 1993. Manual of Mineralogy. John Wiley and Sons, New
- 4. Krauskopf, K.B., 1967. Introduction to Geochemistry. McGraw Hill.
- 5. Mason, B. and Moore, C.B., 1991. Introduction to Geochemistry. Wiley Eastern.
- 5. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and

Interpretation. Longman.

Vocational Skill Enhancement Course (VSC- 4) (Practical) Physical and Structural Geology

Unit - I

Objective: To give knowledge about Geomorphic processes and features with help of models

Outcome: The students get basic knowledge about Geomorphic process

Objective: To understand different features, contours on topographic maps

Outcome: The students understand man made and natural features, contours on different topographic Maps

Unit - 2

Objective: To study clinometers/Brunton compass with their uses

Outcome: The students can able to handle clinometers/Brunton compass

Objective: To identify and describe different types of geological structures

Outcome: The students identify and describe different types of geological structures with the help of Block models

Objective: To study solve structural problems, draw cross of geological maps and describe

Geology, topography

Outcome: The students solve structural problems, draw cross of geological maps and describe

Geology, topography

Credits: 02 Total Marks: 50 Practical: 60

Unit No.	Title of topic and contents	Contact Hours
Ι	Physical Geology: Study of important geomorphological models and Identification of geomorphic features. Reading topographical maps of the Survey of India	04/week
II	Structural Geology: Study of clinometers/Brunton compass Identification of different types of folds/faults from block models Exercises on structural problems Preparation of cross section profile from a Geological map (Horizontal and Inclined series)	04/week

Books

- 1. Arthur Holmes, 1992. Principles of Physical Geology. Chapman and Hall, London.
- 2. Miller, 1949. An Introduction to Physical Geology. East West Press Ltd.
- 3. Spencer, E.V., 1962. Basic concepts of Physical Geology. Oxford & IBH.
- 4. Mahapatra, G.B., 1994. A text book of Physical geology. CBS Publishers.
- 5. Billings, M.P., 1972. Structural Geology. Prentice Hall.
- 6. Davis, G.R., 1984. Structural Geology of Rocks and Region. John Wiley
- 7. Hills, E.S., 1963. Elements of Structural Geology. Farrold and Sons, London.
- 8. Singh, R. P., 1995. Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi

(FP-1/ CP-1)

Title of the paper: FP-1

Credit: 02

Total Marks: 50

Theory: 60 Periods