University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
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5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
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16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
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4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	**Faculty of Humanities,** **Offg. Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Offg. Associate Dean** 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
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AC – 20/05/2025
Item No. – 8.52 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1 & 4		
Name of the Programme – B.Sc. (GEOLOGY)		
Faulty of IDS		
Board of Studies in GEOLOGY		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in GEOLOGY**
Semester		**III & IV**
From the Academic Year		**2025-26**

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:_____ B**	**B.Sc. (GEOLOGY)**
2	**Exit Degree**	**U.G. Diploma in GEOLOGY**
3	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R: _____**	**40%**
5	**Credit Structure** **Sem. III – R. IMU-530C** **Sem. IV – R. IMU-530D**	**Attached herewith**
6	**Semesters**	**Sem. III & IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Under Graduate Diploma in <u>GEOLOGY</u>

Credit Structure (Sem. III & IV)

	R. IMU-530C									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.0	III	6 (2T+2T+ 2PR) Principles of stratigraphy, Descriptive Palaeontology, Principles of stratigraphy Descriptive Palaeontology		4	2	SEC:2, Watershed Management	AEC:2	FP: 2 CC:2	22	**UG Diploma 88**
	R. IMU-530D									
	IV	6 (2T+2T+ 2PR) Essentials of Mineralogy and Mineral Optics, Geomorphology – Landforms and Processes, Essentials of Mineralogy and Geomorphological Mapping		4	2	VSC:2 Surveying and Field Mapping techniques in Geology	AEC:2	CEP: 2 CC:2	22	
	Cum Cr.	28		10	12	6+6	8+4+2	8+4	88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Community Engagement Project, CC – Co-Curricular, RP – Research Project]

Sem. - III

Vertical – 1
Major

Syllabus
B.Sc. (Geology)
(Sem.- III)

Title of Paper: Principles of stratigraphy

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This course introduces the fundamental principles of stratigraphy, focusing on the classification, correlation, and interpretation of layered rock sequences. Students will learn key stratigraphic laws, terminology, and units, along with their applications in geological mapping, resource exploration, and understanding of Earth's history.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims to: 1. Introduce the foundational principles and historical development of stratigraphy, emphasizing its scope and relevance in geological studies. 2. Familiarize students with stratigraphic terminology, laws, and classification systems, including litho-, bio-, and chronostratigraphic frameworks. 3. Equip students with the ability to apply stratigraphic principles in geological mapping, correlation, and the interpretation of Earth's history and basin evolution.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Define and explain key stratigraphic principles and units and describe their historical development and application in Earth sciences. 2. Identify and classify stratigraphic units using lithological, paleontological, and chronological criteria in accordance with international standards. 3. Apply basic laws and stratigraphic methods to interpret geological structures, unconformities, and regional geological histories through correlation and mapping.	

9	**Modules**:- Per credit One module can be created	
	Module 1: Introduction to Stratigraphy	
	1. Definition of stratigraphy: Scope, objectives, and its role in understanding Earth's history 2. Historical development of stratigraphic principles: Contributions of early geologists and the evolution of stratigraphy 3. Branches of stratigraphy: Overview of Litho-, Bio-, Chrono-, Magneto-, and Chemo-stratigraphy 4. Stratigraphic terminology: Concepts of bed, member, formation, group, supergroup, and stratotype 5. Geological time and stratigraphy: Relative and absolute dating principles, correlation with time scales 6. Stratigraphic surfaces and boundaries: Conformities, unconformities, and marker beds, importance of unconformities, Classification and evidence of unconformities 7. Applications of stratigraphy: Use in geological mapping, resource exploration, basin analysis, and paleoenvironmental reconstruction	
	Module 2: Stratigraphic Principles and Units	
	1. Basic laws of stratigraphy: Law of superposition, original horizontality, lateral continuity, cross-cutting relationships, and faunal succession 2. Stratigraphic classification: Lithostratigraphy: Units, nomenclature, lithological correlation 3. Stratigraphic classification: Biostratigraphy: Fossil-based zonation, biozones, index fossils, 4. Stratigraphic classification: Chronostratigraphy: Time-rock units, correlation with geochronologic units 5. Stratigraphic elements: Stratification, facies, sequences, and cyclicity, 6. Stratigraphic units in Lithostratigraphy: Formation, member, bed; principles of mapping and correlation, 7. Stratigraphic units in Biostratigraphy and Chronostratigraphy: Biozones (range, assemblage, abundance), chronostratigraphic units (eonothem to chronozone) and their corresponding geochronologic units (eon to chron).	
10 and 11	**Text and Reference Books:** 1. Butz S. (2007) Science of Earth Systems., (2nd Edition), Thomas Delmar. 2. Lemon, R.R. (1990). Principles of Stratigraphy. Merrill Publishing Company, Ohio. 3. Kumar R. (1996), Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International Limited 4. Weller J.M. (1960), Stratigraphic Principles and Practice, Harper	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**

13	**Continuous Evaluation through:** Class test 1: 5 marks Class Test 2: 5 marks Quizzes, presentation, project, role play, creative writing, assignment etc: 5 marks Attendance and Participation: 5 marks. Total: 20 marks	Theory Exam: 30 marks.

Syllabus
B.Sc. (Geology)
(Sem.- III)

Title of Paper: Descriptive Palaeontology

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This course introduces the principles of palaeontology, focusing on fossilization processes, fossil classification, and the identification of major invertebrate fossil groups. It also explores the applications of fossils and trace fossils in interpreting past environments and geological history, with emphasis on Indian fossil records.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims to: 1. Introduce students to the fundamental concepts of palaeontology, fossilization processes, and the classification of fossils. 2. Develop the ability to identify, describe, and interpret major invertebrate fossil groups and their geological significance. 3. Enable students to understand the role of fossils and trace fossils in reconstructing palaeoenvironments and geological history.	

8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Define and explain key palaeontological concepts, fossilization modes, and the significance of fossil preservation. 2. Identify and classify important invertebrate fossil groups (e.g., Trilobites, Brachiopods, Molluscs, Corals, Graptolites) and describe their Indian occurrences. 3. Interpret fossil assemblages and trace fossils to reconstruct depositional environments and assess their palaeoecological and stratigraphic relevance.

9	**Modules**:- Per credit One module can be created	
	Module 1: Fundamentals of Fossils and Fossilization	
	1. Definition and scope of Palaeontology, types of fossils, and basic fossil classification 2. Processes of fossilization and modes of fossil preservation 3. Preservation potential of organisms and factors influencing fossil records 4. Fossil collection methods and documentation techniques 5. Applications of fossils: in stratigraphy, correlation, and palaeoenvironmental analysis 6. Basics of taxonomy and nomenclature of fossils 7. Introduction to ichnology, classification and nomenclature of trace fossils, and ichnofacies concept	
	Module 2: Invertebrate Fossils and Indian Occurrences	
	1. Trilobita: Morphology, classification, and Indian examples, 2. Brachiopoda and Mollusca (Gastropods, Lamellibranchs, Cephalopods): Key features and fossil record, 3. Echinodermata and Hemichordata (Graptolites): Morphology, classification, and significance, 4. Cnidaria: Corals and reef-building organisms, 5. Geological distribution of key invertebrate fossil groups in India, 6. Environmental significance of fossil groups in palaeoenvironmental reconstruction, 7. Overview of extinction events relevant to major fossil groups.	
10 and 11	**Text and Reference Books:** 1. Benton, M.J. and Harper, D.A.T. (2009) – *Introduction to Paleobiology and the Fossil Record*, Wiley-Blackwell Publication. 2. Clarkson, E. N.K.(2012)Invertebrate Paleontology and evolution 4th Edition by Blackwell Publishing. 3. Dasgupta, A. (2005) – *Introduction to Palaeontology* (1st Edition), World Press. Jain, S. (2017) – *Fundamentals of Invertebrate Palaeontology: Macrofossils*, Springer. ISBN: 978-81-322-3656-6 | eBook: 978-81-322-3658-0 | DOI: 10.1007/978-81-322-3658-0 4. Ray, Anis. K. (2008) – *Fossils in Earth Sciences*, Prentice Hall of India.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**

13	**Continuous Evaluation through:** Class test 1: 5 marks Class Test 2: 5 marks Quizzes, presentation, project, role play, creative writing, assignment etc: 5 marks Attendance and Participation: 5 marks. Total: 20 marks	Theory Exam: 30 marks.

Syllabus
B.Sc. (Geology)
(Sem.- III)

Title of Paper: <u>Practical Course - Principles of stratigraphy Descriptive Palaeontology</u>

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**Practical- Principles of stratigraphy Descriptive Palaeontology**
2	**Vertical :**	Major
3	**Type :**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims : 1. To introduce students to practical methods used in stratigraphic correlation, fossil identification, and paleoenvironmental reconstruction. 2. To develop observational and interpretative skills through the study of fossil specimens, stratigraphic sections, and geological maps. 3. To enable students to apply stratigraphic laws and paleontological data in understanding Earth's history and geological events.	

8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Interpret and correlate stratigraphic sections using lithological features and fossil data. 2. Identify and describe common invertebrate fossils, including their morphology, preservation, and stratigraphic significance. 3. Apply stratigraphic principles and trace fossil analysis to reconstruct geological history and palaeoenvironments.

9	**Modules**:- Per credit One module can be created
	Module 1: Stratigraphy
	● Stratigraphic correlation using lithological and paleontological data ● Preparation and interpretation of range charts for fossil distribution ● Interpretation of geological cross-sections based on stratigraphic principles ● Identification of various types of unconformities and application of stratigraphic laws ● Chronological reconstruction of geological events using stratigraphic sequences ● Methods of collecting and recording stratigraphic data from the field ● Understanding the relationship between stratigraphy and palaeontology in geological interpretations
	Module 2:Descriptive Palaeontology practical
	● Study of fossil specimens showing different modes of preservation (e.g., moulds, casts, permineralization) ● Identification and description of invertebrate fossils: morphology, classification and age significance ● Systematic and stratigraphic position of key fossil groups (Trilobita, Brachiopoda, Mollusca, Echinodermata etc.) ● Functional morphology of selected fossil groups and palaeoecological adaptations ● Recognition of major mass extinction events through fossil evidence ● Introduction to ichnology: basic principles, types of trace fossils, ichnofacies and their environmental interpretation
10 and 11	**Text and Reference Books:** 1. Benton, M.J. and Harper, D.A.T. (2009) – *Introduction to Paleobiology and the Fossil Record*, Wiley-Blackwell Publication. 2. Butz S. (2007) Science of Earth Systems., (2nd Edition), Thomas Delmar. 3. Clarkson, E. N.K.(2012)Invertebrate Paleontology and evolution 4th Edition by Blackwell Publishing. 4. Dasgupta, A. (2005) – *Introduction to Palaeontology* (1st Edition), World Press. Jain, S. (2017) – *Fundamentals of Invertebrate Palaeontology: Macrofossils*, Springer. ISBN: 978-81-322-3656-6 | eBook: 978-81-322-3658-0 | DOI: 10.1007/978-81-322-3658-0 5. Lemon, R.R. (1990). Principles of Stratigraphy. Merrill Publishing Company, Ohio. 6. Kumar R. (1996), Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International Limited

	7. Ray, Anis. K. (2008) – *Fossils in Earth Sciences*, Prentice Hall of India. 8. Weller J.M. (1960), Stratigraphic Principles and Practice, Harper	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
13	**Continuous Evaluation through:** Viva: 10 marks. Journal: 05 marks Attendance/Participation: 05 marks. Total: 20 marks.	Practical: 30 marks

Vertical - 4

SEC

Syllabus
B. Sc. (Geology)
(Sem.- III)

Title of Paper: <u>Watershed Management</u>

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This course provides a comprehensive understanding of watershed management, focusing on the hydrological, ecological, and planning aspects essential for sustainable land and water resource development. It covers fundamental principles, land use planning, water quality, soil conservation, and integrated approaches for managing watersheds effectively.
2	**Vertical :**	SEC
3	**Type :**	Theory and Practical
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	15 hours + 30 hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims to: 1. Introduce the key principles, hydrological processes, and land-water interactions within a watershed system. 2. Develop knowledge of water and soil conservation techniques and erosion control. 3. Equip students with the skills to apply integrated and multidisciplinary strategies in watershed planning and management.	

8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Explain the fundamental concepts of watershed processes, including runoff, infiltration, and water quality. 2. Analyze and apply strategies for erosion control and sedimentation management. 3. Design integrated watershed management plans using multidisciplinary approaches for sustainable development.

9	**Modules**:- Per credit One module can be created	
	Module 1: Fundamentals of Watershed Management	
	1. Principles and Concepts of watershed management 2. Hydrological cycle and process in Watershed 3. Stream flow, river systems, runoff, infiltration 4. Land Use Planning and water management 5. Water Quality parameters, water quality management and monitoring. 6. Soil Erosional processes, Erosion control and Sedimentation. 7. Multidisciplinary approaches in watershed management.	
	Module 2: Practical on Watershed Management	
	1. Delineation of Stream and watershed. 2. Stream ordering based on Shreve's/Strahler's Scheme. 3. Identification of the longest river in the watershed. 4. Calculation of morphometric parameters: Stream number, Stream length, Mean stream length, Stream length ratio, Bifurcation ratio.	
10 and 11	**Text and Reference Books:** 1. Das, M. M., & Saikia, M. D. (2012). *Watershed Management*. New Delhi: PHI Learning. 2. France, R. L. (2006). *Introduction to Watershed Management: Understanding and Managing the Impacts of Sprawl*. Lanham, MD: Rowman & Littlefield. 3. Heathcote, I. W. (2009). *Integrated Watershed Management: Principles and Practice*. Chichester, UK: Wiley. 4. Murty, J. V. S. (1994). *Watershed Management*. New Delhi: New Age International. 5. Rajora, R. (1998). *Integrated Watershed Management: A Field Manual for Equitable, Productive and Sustainable Development*. Jaipur: Rawat Publications. 6. Randhir, T. (2006). *Watershed Management*. London: IWA Publishing.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60%** **Individual Passing in Internal and External Examination**

13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc. 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks.

Sem. - IV

Vertical – 1
Major

Syllabus
B.Sc. (Geology)
(Sem.- IV)

Title of Paper: Essentials of Mineralogy and Mineral Optics

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This course introduces students to the fundamentals of optical mineralogy and the systematic classification of common rock-forming minerals. Students will explore the behavior of light in minerals, optical properties, and mineral identification techniques using polarizing microscopes. The course also includes a detailed study of silicate mineral structures and groups such as olivines, pyroxenes, amphiboles, feldspars, and zeolites, with emphasis on their physical and optical characteristics, occurrence, and geological significance.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims: 1. To provide foundational knowledge of light behavior and optical principles relevant to mineral identification. 2. To train students in the use of optical tools and techniques, including the polarizing microscope and optical tests. 3. To develop a systematic understanding of silicate mineral structures and their classification based on physical and optical properties.	

8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Explain the principles of optical mineralogy and use optical tools for mineral identification. 2. Identify and interpret key optical properties such as relief, pleochroism, birefringence, and optic sign. 3. Classify and describe common rock-forming mineral groups based on their structural, physical, and optical characteristics.

9	**Modules**:- Per credit One module can be created
	Module 1:Fundamentals of Optical Mineralogy
	1. Nature of light: Differences between non-polarised and polarised light Concepts of refraction and double refraction 2. Introduction to the polarizing microscope and its applications in mineralogy 3. Basic optical characteristics of minerals: Relief, pleochroism, birefringence, and interference/polarisation colours 4. Construction and working of Nicol prism and polaroid filter 5. Usage of simple optical tools in mineral identification 6. Techniques such as Becke's test, Michel-Lévy Birefringence Chart, and extinction angles 7. Understanding interference figures and determination of optic sign
	Module 2: Systematic Study of Common Rock-Forming Mineral Groups
	Classification of silicate minerals based on their structural arrangement Systematic study of common rock-forming mineral groups with emphasis on their physical and optical properties, mode of occurrence, and geological significance: 1. Olivine group 2. Garnet group 3. Pyroxene group 4. Amphibole group 5. Mica group 6. Silica (Quartz) group 7. Feldspar group 8. Feldspathoid group

10 and 11	**Text and Reference Books:** 1. Berry, L.G., Mason, B.H., & Dietrich, R.V. (1983). *Mineralogy: Concepts, Descriptions, Determinations*. W.F. Freeman and Co. 2. Cornelius, K., & Hurlbut Jr., C.S. (1994). *Manual of Mineralogy* (21st Edition) and *Minerals and Rocks Exercises in Crystallography*. J. Wiley Sons. 3. Dana, J.D., & Ford, W.E. (Rev. ed.) (2010). *Dana's Manual of Mineralogy*. J. Wiley Sons. 4. Deer, W.A., Howie, A.H., & Zussman, J. (1992). *An Introduction to the Rock-Forming Minerals*. Longman Scientific and Technical. 5. Kerr, P.F. (1977). *Optical Mineralogy* (4th ed.). McGraw-Hill Co. Inc., New Delhi. 6. Nesse, W.D., & Schulze, D.J. (2004). *Introduction to Optical Mineralogy* (3rd Edition) and *An Atlas of Minerals in Thin Section*. Oxford University Press. 7. Perkins, D. (2011). *Mineralogy* (International Edition). Pearson Education. 8. Read, H.H. (Rev. ed. C.D. Gribble) (1988). *Rutley's Elements of Mineralogy* (27th Edition). CBS Publications. 9. Shelly, D. (1985). *Optical Mineralogy* (2nd Edition). Elsevier. 10. Wenk, H.R., & Bulakh, A. (2004). *Minerals: Their Constitution and Origin*. Cambridge University Press.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
13	**Continuous Evaluation through:** Class test 1: 5 marks Class Test 2: 5 marks Quizzes, presentation, project, role play, creative writing, assignment etc: 5 marks Attendance and Participation: 5 marks. Total: 20 marks	Theory Exam: 30 marks.

Syllabus
B.Sc. (Geology)
(Sem.- IV)

Title of Paper: <u>Geomorphology – Landforms and Processes</u>

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This course explores the development of Earth's surface features through the action of geomorphic processes and agents such as rivers, glaciers, wind, waves, and groundwater. It covers the role of geological structures, weathering, and human activities in shaping landforms, with a focus on both global and Indian geomorphosites. The influence of climate and sea level changes on landform evolution is also examined.

2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims: 1. To introduce the principles of landscape evolution and the feedback mechanisms operating within geomorphic systems. 2. To study landforms produced by different geomorphic agents, including structural, fluvial, eolian, glacial, karst, and coastal processes. 3. To evaluate the impact of climatic fluctuations, sea-level changes, and anthropogenic activities on landform development.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Describe the processes and agents responsible for shaping Earth's surface and classify the resulting landforms. 2. Analyze the influence of structural features, weathering, and climatic factors in the formation of landscapes. 3. Interpret and compare landform types using examples from Indian geomorphosites and global environments.	

9	**Modules**:- Per credit One module can be created
	Module 1: Evolution of Landscapes and Landforms Created by Geomorphic Agents – I
	1. Geomorphic systems of landscapes and their feedback mechanisms 2. Human impact on landforms

	3. Indian geomorphosites and their classification Landforms created by various geomorphic agents – Part I: 4. Structural landforms: Features associated with folds, faults, and shear zones 5. Volcanogenic landforms: Types of volcanoes, intensity classification, and associated geomorphological features 6. Weathering-induced landforms: Forms developed through physical, chemical, and biological weathering 7. Fluvial landforms: River channels and associated erosional, depositional, and floodplain features	
	Module 2:Landforms Created by Geomorphic Agents – II	
	1. Eolian landforms: Erosional and depositional features shaped by wind processes 2. Karst landforms: Dolines, sinkholes, poljes, and other features formed through solution and subsurface processes 3. Glacial and glacio-fluvial landforms: Landforms produced by glacial erosion, deposition, and meltwater processes 4. Coastal landforms: Erosional and depositional features shaped by marine processes 5. Climatic and sea level change influence on landforms.	
10 and 11	**Text and Reference Books:** 1. Charlton, R. (2007). *Fundamentals of Fluvial Geomorphology* (1st Edition). United Kingdom: Taylor & Francis. 2. Doornkamp, J.C., & King, C.A.M. (1971). *Numerical Analysis in Geomorphology – An Introduction*. London: Butler and Tanner. 3. Gutierrez, M. (2013). *Geomorphology*. Netherlands: CRC Press – Taylor & Francis Group. 4. Huggett, R.J. (2003). *Fundamentals of Geomorphology* (4th Edition). United Kingdom: Routledge. 5. Judson, S., & Kauffman, M.E. (1990). *Physical Geology* (8th Edition). Prentice Hall. 6. Kale, V. (2017). *Atlas of Geomorphosites in India – Glimpses of India's Incredible Geodiversity and Geoheritage*. Indian Institute of Geomorphologists. ISBN: 978-93-5268-858-6. 7. Kale, V. (2018). *Atlas of Geomorphosites of Maharashtra – Glimpses of the Amazing Geodiversity and Geoheritage of the Deccan Traps*. Indian Institute of Geomorphologists. ISBN: 978-93-5311-580-7. 8. King, C.A.M. (1967). *Techniques in Geomorphology*. London: Edward Arnold. 9. Mitchell, C.W. (1973). *Terrain Evaluation*. London: Longman Publications. 10. Morisawa, M. (1985). *Rivers – Form and Process*. London: Longman Publications. 11. Saha, P., & Basu, P. (2004). *Advanced Practical Geography – A Laboratory Manual*. Kolkata, India: Books and Allied (P) Ltd. 12. Selby, M.J. (1985). *Earth's Changing Surface – An Introduction to Geomorphology*. Oxford University Press. 13. Zavoianu, I. (1985). *Morphometry of Drainage Basins*. Amsterdam: Elsevier.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**

13	**Continuous Evaluation through:** Class test 1: 5 marks Class Test 2: 5 marks Quizzes, presentation, project, role play, creative writing, assignment etc: 5 marks Attendance and Participation: 5 marks. Total: 20 marks	Theory Exam: 30 marks.

Syllabus
B.Sc. (Geology)
(Sem.- IV)

Title of Paper: <u>Practical Course – Essentials of Mineralogy and Geomorphological Mapping</u>

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	This practical course provides hands-on training in the use of the petrographic microscope for mineral identification and introduces students to key optical properties of rock-forming minerals under plane and cross-polarized light. It also develops essential skills in interpreting geomorphological features using Survey of India toposheets, constructing various topographical profiles, and conducting basic drainage basin analysis through established geomorphological mapping methods.
2	**Vertical :**	Major
3	**Type :**	Practical
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	50 Marks

7	**Course Objectives**: (List some of the course objectives) The course aims : 1. To equip students with the ability to operate a petrographic microscope and identify minerals based on their physical and optical properties. 2. To develop a foundational understanding of common rock-forming minerals, their field characteristics, and associations. 3. To train students in the interpretation of toposheets, construction of profiles, and application of geomorphological mapping techniques for terrain analysis.
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Use a petrographic microscope to observe and identify common rock-forming minerals under PPL and XPL. 2. Analyze the physical and optical properties of 20 essential minerals and relate them to their geological occurrence. 3. Interpret geomorphological features and drainage basin characteristics from toposheets using Savigear's method and profile construction techniques.

9	**Modules**:- Per credit One module can be created
	Module 1: Essentials of Mineralogy (Practical)
	1. Introduction to Optical Mineralogy Basics of optical mineralogy and principles of Polarized Light Microscopy (PLM) Understanding the petrographic microscope Exploration of microscope parts and their functions Handling the microscope; identifying minerals under Plane Polarized Light (PPL) and Cross Polarized Light (XPL) 2. **Identification of 20 Common Rock-Forming Minerals** Detailed study of each mineral focusing on physical and optical properties, mode of occurrence, mineral associations, and rock types
	Module 2:Geomorphological Mapping and Toposheet Interpretation (Practical)
	1. Toposheet Interpretation and Feature Identification ● Identification and marking of geomorphological features on Survey of India toposheets ● Interpretation of drainage patterns, slopes, and landforms **2. Topographical Profiling Techniques** ● Preparation of topographical profiles: ● Projected profiles ● Superimposed profiles ● Spur profiles ● Cross valley profiles **3. Geomorphological Mapping Methodology** ● Application of Savigear's Method for landform mapping and interpretation

	● Drainage Basin Analysis from a toposheet – Linear Aspects. ● Drainage Basin Analysis from a toposheet – Areal Aspects.	
10 and 11	**Text and Reference Books:** 1. Berry, L.G., Mason, B.H., & Dietrich, R.V. (1983). *Mineralogy: Concepts, Descriptions, Determinations*. W.F. Freeman and Co. 2. Cornelius, K., & Hurlbut Jr., C.S. (1994). *Manual of Mineralogy* (21st Edition). J. Wiley Sons. 3. Dana, J.D., & Ford, W.E. (Rev. ed.) (2010). *Dana's Manual of Mineralogy*. J. Wiley Sons. 4. Deer, W.A., Howie, A.H., & Zussman, J. (1992). *An Introduction to the Rock-Forming Minerals*. Longman Scientific and Technical. 5. Kerr, P.F. (1977). *Optical Mineralogy* (4th ed.). McGraw-Hill Co. Inc., New Delhi. 6. King, C.A.M. (1967). *Techniques in Geomorphology*. Edward Arnold, London. 7. Nesse, W.D., & Schulze, D.J. (2004). *Introduction to Optical Mineralogy* (3rd Edition) and *An Atlas of Minerals in Thin Section*. Oxford University Press. 8. Saha, P., & Basu, P. (2004). *Advanced Practical Geography – A Laboratory Manual*. Books and Allied (P) Ltd., Kolkata, India. Shelly, D. (1985). *Optical Mineralogy* (2nd Edition). Elsevier. 9. Selby, M.J. (1985). *Earth's Changing Surface – An Introduction to Geomorphology*. Oxford University Press. 10. Zavoianu, I. (1985). *Morphometry of Drainage Basins*. Elsevier, Amsterdam.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
13	**Continuous Evaluation through:** Viva: 10 marks. Journal: 05 marks Attendance/Participation: 05 marks. Total: 20 marks**.**	Practical: 30 marks

Vertical - 4

VSC

Syllabus
B. Sc. (Geology)
(Sem.- IV)

Title of Paper: <u>Surveying and Field Mapping techniques in Geology</u>

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	Surveying and Field Mapping techniques in Geology
2	**Vertical :**	VSC
3	**Type :**	Theory and Practical
4	**Credit**:	2 credits / (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	15 hours + 30 hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) The course aims to: 1. Equip students with the skills to conduct land surveys using simple and standard equipment such as auto-level, dumpy level, and theodolite. 2. Enable students to create accurate survey maps and documents representing the surveyed area and geological features. 3. Develop the ability to analyze geological formations by calculating true and apparent thicknesses and preparing detailed geological maps.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course, students will be able to: 1. Recall and demonstrate the use of basic surveying instruments for accurate distance measurement in geological fieldwork. 2. Interpret topographic, drainage, and soil features to support geological mapping and terrain analysis.	

	3. Apply plane table and other survey techniques to generate accurate geological maps, cross-sections, and correct errors in field measurements.

9	**Modules**:- Per credit One module can be created	
	Module 1: Surveying and Methods of Geological Mapping.	
	1. Definition, objectives, types of surveying. 2. Measuring distance: direct measurement, instruments for distance measurement, errors in measurement. 3. Compass survey: Tape and compass, Plane table survey, Theodolite survey, Total station survey, Levelling. 4. Traverse mapping, contact mapping, exposure mapping, Detailed/small scale mapping. 5. Use of topography, drainage and soil in geological mapping. 6. Make a field map and cross section.	
	Module 2: Practical on Surveying and Methods of Geological Mapping.	
	1. Structure problem: width of outcrop, true thickness. 2. Surveying: tape and compass, Levelling using Auto level. 3. Plane table survey. 4. Theodolite- Tacheometry. 5. GPS survey.	
10 and 11	**Text and Reference Books:** 1. Coe A.L. (ed). (2010) Geological Field Techniques., Wiley - Blackwell. 2. Compton R.R (1985) Geology in the field., John Wiley. 3. Gokhale N. W. (2009) A guide to Field Geology., CBS Publishers and Distributors Pvt. Ltd. 4. Kanetkar T.P and Kulkarni S.V (1993) Surveying and levelling - Part 1, (23rd ed.) Reprint 1993., Pune vidyarthi Griha Prakashan. 5. Mathur S.M. (2010) Guide to Geology., PHI Learning Pvt.Ltd. 6. Regan D.M. (2019) Structural Geology - An Introduction to geometrical techniques. (4th ed.), John Wiley.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**

13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc. 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks.

QUESTION PAPER PATTERN

(External and Internal)

A. Evaluation of the Major (mandatory) Theory courses: 50 marks.

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

Internal assessment: 20 marks.

a. Class test 1: 05 marks
b. Class Test 2: 05 marks
c. Quizzes, presentation, project, role play, creative writing, assignment etc. 05marks
d. Attendance and Participation: 05 marks.

External Examination for Major (Mandatory) Theory Courses (2Credits) – 30 Marks

Duration: 1 Hour

Theory question paper pattern:

Question no	Module	Question	Marks
Q1	I	Any 1 out of 2 (1 or 1 a, b)	10
Q2	II	Any 1 out of 2 (1 or 1 a, b)	10
Q3	I&II	2 questions from each module attempt any two	10
		Total	30

B. Evaluation for Major (Mandatory) Practical Courses (2 Credits): 50 marks.

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment).

The evaluation pattern would be as follows:

Each practical course carries a total of 50 Marks, distributed as follows:

Internal Assessment: 20 marks.

The criteria would be as follows:

NO	Criterion	Marks
1	Journal	05
2	Class test	10
3	Attendance/Participation	05
	Total	**20**

External Assessment: 30 Marks:
The practical question paper pattern would be as follows:

Question	Criterion	Marks
Q1	Practical performance	25
Q2	Viva	05
	Total	**30**

- The duration of each practical course evaluation is 2 hours.
- To be eligible for evaluation, students must complete a minimum of 80% of the practical work assigned in each core subject.
- It is mandatory for students to submit a certified journal at the time of the practical examination. The journal serves as a record of their practical work and is an essential component of the evaluation process.

C. Evaluation for Vocational Skill Course(VSC) and Skill Enhancement Cources (SEC): 50 Marks The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment).

The evaluation pattern would be as follows: Internal Assessment: 20 marks.

- Theory Component: 10 marks. Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10 marks
- Practical Component: 10 marks. Journal: 05 marks Attendance and Participation: 05 marks.

External Assessment: 30 marks.
Theory Component: 15 marks.
Duration: 1 Hour Theory question paper pattern:

Question NO	Module	Question	Marks
Q1	I	Any 1 out of 2 (1 or 1a, b)	7
Q2	I	Any 1 out of 2 (2 or 2a, b)	8
		Total	15

Practical Component: 15 marks.
Assessment of these questions would be done at the time of Major Practical External Assessment. The marks earned by the candidate would be added to the theory component to make a total of 30 marks of External Assessment.

Question NO	Module	Question	Marks
Q1	II	Practical Performance	10
Q2	II	Viva	5
		Total	15

Regulations regarding the scheme of exams, number of credits and standard of passing will be as prescribed by the University of Mumbai.

A student is said to have passed if he/she secures 40% of marks allotted in each head of passing.

External evaluation of 30 marks and Internal evaluation of 20 marks are treated as separate heads of passing.

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-	Sd/-	Sd/-	Sd/-
Sign of the BOS Chairman Board of Studies in Geology	**Sign of the Offg. Associate Dean Dr. C.A.Chakradeo Faculty of Interdisciplinary Studies**	**Sign of the Offg. Associate Dean Dr. Kunal Ingle Faculty of Interdisciplinary Studies**	**Sign of the Offg. Dean Prof. A. K. Singh Faculty of Interdisciplinary Studies**