SYLLABI AND SCHEME OF EXAMINATIONS FOR DISCIPLINE SPECIFIC COURSES OF MULTIDISCIPLINARY PROGRAMS WITH HONS. IN ONE MAJOR DISCIPLINE B.SC. (PHYSICAL SCIENCES) WITH HONS. IN GEOLOGY/HONS. WITH RESEARCH IN GEOLOGY

(Based on Curriculum and Credit Framework guidelines for UG Programs under NEP 2020)

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

WITH EFFECT FROM THE SESSION 2026-27

This Scheme and Syllabi will also be applicable for the students admitted in 2025-26 from Semester 3rd onwards and for the students admitted in 2024-25 from Semester 5th onwards.

Credit Structure for Undergraduate Programmes (Multidisciplinary with Hons. in One Major Discipline)

Semester	Discipline-Specific Courses (DSC) / Major courses	Minor(MIC)/ Vocational (VOC)/ Skill Enhancement Courses (SEC)/ Internship	Multidisciplinary courses(MDC)	Ability Enhancement courses(AEC)	Research project/ Dissertation	Value-Added Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits	MIC1 @ 4 credits	MDC1 @ 3 credits	AEC1 @ 2 credits	----------	----------	24
	DSC - B1 @ 4 credits	SEC1@ 3 credits**					
	DSC - C1 @ 4 credits						
II	DSC - A2 @ 4 credits	SEC2 @ 3 credits**	MDC2 @ 3 credits	AEC2 @ 2 credits	----------	VAC1 @ 2 credits VAC2 @ 2 credits	24
	DSC – B2 @ 4 credits						
	DSC – C2 @ 4 credits						
Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/ Subject							
III	DSC – A3 @ 4 credits	MIC2 @ 4 credits	MDC3 @ 3 credits	AEC3 @ 2 credits		----------	24
	DSC – B3 @ 4 credits	SEC3@ 3 credits**					
	DSC – C3 @ 4 credits						
IV	DSC – A4 @ 4 credits	MIC3(VOC)@ 4 credits	----------	AEC4 @ 2 credits	----------	VAC3 @ 2 credits	20
	DSC – B4 @ 4 credits						
	DSC – C4 @ 4 credits						
Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC – A5 @ 4 credits	MIC4(VOC)@ 4 credits	----------	----------	----------	----------	20
	DSC – B5 @ 4 credits	Internship @ 4 credits#					
	DSC – C5 @ 4 credits						
VI	DSC – A6 @ 4 credits	MIC5 @ 4 credits	----------	----------	----------	----------	20
	DSC – B6 @ 4 credits	MIC6(VOC)@ 4 credits					
	DSC – C6 @ 4 credits						
Students will be awarded 3-year UG Degree in the relevant Discipline/Subject upon securing 132 credits.							
VII*	DSC – H1 @ 4 credits	SEC4 @ 4 credits OR MIC7 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	----------	----------	24
	DSC – H2 @ 4 credits						
	DSC – H3 @ 4 credits						
	DSC – H4 @ 4 credits						
	DSC – H5 @ 4 credits						
VIII* (4yr UG Hon.)	DSC – H6 @ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	----------	----------	24
	DSC – H7 @ 4 credits						
	DSC – H8 @ 4 credits						
	DSC – H9 @ 4 credits						
	DSC – H10 @ 4 credits						
VIII* (4yr UG Hon. with Research)	DSC – H6@ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	Research project/ Dissertation@ 12 credits	----------	24
	DSC – H7@ 4 credits					TOTAL CREDITS	180

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* Student should select one major discipline (Out of A, B, or C studied during first three years of UG Programmes) in which he/she wishes to pursue Honors. This framework is subject to modification as per UGC guidelines at the University level. The universities may decide to offer the Honors degree Programmes subject to the fulfillment of credit point table

** SEC for imparting practical skills related to Major (A, B and C)/minor.

#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

Discipline Specific Courses/ Major Course			Credits Distribution			Total Credits	Workload			Total Workload	Marks			
	Nomenclature of Course	Course Code	L	T	P		L	T	P		Theory		Practical	Total Marks
											Internal	External	Only Internal	
Semester I														
DSC @ 4 credits	Introduction to Geology	**24GOLM401DS01**	3	0	1	4	3	0	2	5	25	50	25	100
Semester II														
DSC @ 4 credits	Mineralogy and Crystallography	**24GOLM402DS01**	3	0	1	4	3	0	2	5	25	50	25	100
Semester III														
DSC @ 4 credits	Petrology	**25GOLM403DS01**	2	0	2	4	2	0	4	6	15	35	50	100
Semester IV														
DSC @ 4 credits	Structural Geology	**25GOLM404DS01**	2	0	2	4	2	0	4	6	15	35	50	100
Semester V														
DSC @ 4 credits	Palaeontology	**26GOLM405DS01**	2	0	2	4	2	0	4	6	15	35	50	100
Semester VI														
DSC @ 4 credits	Stratigraphy	**26GOLM406DS01**	2	0	2	4	2	0	4	6	15	35	50	100

L: Lecture; T: Tutorial; P: Practical

Note: The Syllabi and Scheme of Examinations (SOE) for Discipline Specific Courses/Major Courses for UG Semester 7 and Semester 8 will be same as applicable for Syllabi and S.O.E. for UG (Single Major) semester 9 and semester 10 respectively

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Introduction to Geology	**Course Code**	24GOLM401DS01
Hours per Week	03 Hours	**Credits**	03 (L:3, P:0)
Maximum Marks	75 {External (term-end exam) – 50} (Internal – 25)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting at least one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02) and out of which the student will be required to attempt any 05 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each from all the four units.

Course Learning Outcomes (CLO): Upon successful completion of this course:
CLO1:Students will understand the origins of the solar system and the Earth
CLO 2: Understanding about the dynamics of Earth's surface and interior
CLO 3: Students will be able to understand Plate tectonic processes which is the main driving force around.

Unit 1: Introduction to Geology and its branches. Earth and solar system, Earth's origin, size, shape, mass, density and its atmosphere. Various theories regarding the origin of the earth; Internal structure of the Earth and its composition. Law of uniformitarianism.

Unit 2: Types of rocks and rock cycle. Rocks weathering, erosion, types of weathering and factors affecting weathering. Continental drift and Plate tectonics, Earth's gravity and magnetic fields, Elementary idea of bed, dip and strike. Outcrop, outlier, inlier and overlap

Unit 3: Soil formation, soil profile. Geological work of a river: Erosional and depositional features produced by the river. Wind: Study of important erosional and depositional landforms formed by wind.

Unit 4: Glacier: landforms formed by erosion, transportation and deposition by glaciers. Lacustrine deposits and Important Indian Lakes of geological significance. Geological landforms formed by groundwater.

References:

1. Mukherjee, A. D. (2009). *Textbook of Geology*. World Press.
2. Mahapatra, S. N. (2014). *A Textbook of Geology: An Introduction to Geology*.
3. Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall, London.
4. The Principles of Petrology- G. W. Tyrell.
5. Press, F., & Siever, R. (2000). *Understanding Earth* (4th ed.). W.H. Freeman.
6. Billings, M.P.(1972). Structural Geology. Prentice Hall.
7. Plate Tectonics and Crustal Evolution- K.C. Condie
8. Valdiya, K. S. (2001). *Geology of India: Textbook for Indian Universities*.
9. Suggested Links:

https://www.mooc-list.com/course/science-solar-system-coursera
https://www.mooc-list.com/course/planet-earth-and-you-coursera
https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
https://www.classcentral.com/course/swayam-structural-geology-14312
https://www.mooc-list.com/course/origins-formation-universe-solar-systemearth-and_lifecoursera

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical(Introduction to Geology)	**Course Code**	24GOLM401DS01
Hours per Week	02 Hours	**Credits**	01 (L:0 , P:1)
Maximum Marks	25	**Time of Examinations**	1.5 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paper will set by the internal examiner. The distribution of Marks will be as follows:

Marks for Question Paper:	12
Marks for Practical Record Book:	05
Marks for Viva-Voce:	03
Attendance :	05
Total:	25

Course Learning Outcomes (CLO):

CLO 1: Upon successfully completing this course, students will learn the use of Brunton compass and clinometer.

CLO 2: Students will understand the interior of Earth and various processes happing on the surface and in the subsurface

CLO 3: Students will be able to learn about measuring and representing the attitude of a bedding or inclined plane

CLO 4: Students will be able to recognize various structures of rocks on a map

List of Practicals:

1. Study of important geomorphological models
2. Reading topographical maps of the Survey of India; Identification of geomorphic features.
3. Bearing: Whole circle and Quadrant bearing
4. Clinometer and Brunton compass and their uses.
5. Exercises on structural problems: preparation of cross-section profile from a geological map.

References:

1. Compton, R. R. (1985). *Manual of Field Geology*. John Wiley & Sons.
2. Rutherford, M. J. (2001). *Introducing Geology: A Guide to the World of Rocks*. Dunedin Academic Press.
3. Marshak, S. (2019). *Laboratory Manual for Introductory Geology*. W.W. Norton & Company
4. Smith, J., & Johnson, A. (2023). *Practical Manual of Structural Geology* (2nd ed.). Geological Society Publishing House
5. Suggested Links: **https://www.geokniga.org/bookfiles/geokniga-structural-geology_1.pdf**

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Mineralogy and Crystallography	**Course Code**	24GOLM402DS01
Hours per Week	03 Hours	**Credits**	03 (L:3, P:0)
Maximum Marks	75 {External (term-end exam) – 50} (Internal – 25)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting at least one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02) and out of which the student will be required to attempt any 05 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each from all the four units.

Course Learning Outcomes (CLO):

CLO 1: Identify and classify common minerals based on physical properties such as cleavage, hardness, and luster.

CLO 2: Understand the principles of crystallography and crystal symmetry.

CLO 3: Evaluate the geological significance of mineral occurrences based on their physical and chemical properties.

CLO 4: Apply mineralogical knowledge to interpret geological processes and environments.

CLO 5: Apply crystallographic knowledge to understand materials science, mineralogy.

Unit 1: Definition and classification of minerals; Silicate structure and classification of silicates. Elementary ideas about atomic minerals. Polymorphism, Isomorphism and Pseudo-morphism. Physical properties of minerals.

Unit 2: ElementaryIdeas about crystal structures, Crystal faces, edges, solid angle and zones, type of forms. Interfacial angle and its measurement. Law of constancy of interfacial angles. Twinning and its types. Parameter System of Weiss. Index system of miller.

Unit 3: Study of Physical Properties, chemical composition, systematic classification and mode of occurrence of the rock forming group (i) Silica group, (ii) Pyroxene group and (iii) Mica group

Unit 4: Study of Physical Properties, chemical composition, systematic classification and mode of occurrence of the rock forming group (i) Feldspar group, (ii)Amphibole group and (iii) Garnet group

References:

1. Klein, C., & Dutrow, B. (2017). *Manual of Mineral Science* (23rd ed.). John Wiley & Sons.
2. Deer, W. A., Howie, R. A., & Zussman, J. (2013). *An Introduction to the Rock-Forming Minerals* (3rd ed.). Mineralogical Society of Great Britain and Ireland.
3. Nesse, W. D. (2021). *Introduction to Mineralogy* (3rd ed.). Oxford University Press.
4. Pellant, C. (2002). *Rocks and Minerals* (Smithsonian Handbooks). DK Publishing.
5. Phillips, D. C. (1971). *Introduction to Crystallography* (4th ed.). Chapman & Hall.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical (Mineralogy and Crystallography)	**Course Code**	24GOLM402DS01
Hours per Week	02 Hours	**Credits**	01 (L:0, P:1)
Maximum Marks	25	**Time of Examinations**	1.5 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paper will set by the internal examiner.The distribution of Marks will be as follows:

Marks for Question Paper:	12
Marks for Practical Record Book:	05
Marks for Viva-Voce:	03
Attendance :	05
Total:	25

Course Learning Outcomes (CLO):

CLO 1: Students will be able to identify common minerals using physical properties.

CLO 2: Students will understand the principles of crystal symmetry and be able to describe crystal structures using crystallographic notation.

CLO 3: Students will develop proficiency in using laboratory equipment and techniques for mineral identification and crystallographic analysis.

CLO 4: Students will classify minerals based on their chemical composition, physical properties, and crystal structures.

CLO 5: Students will be able to analyze and interpret experimental data obtained from mineralogical and crystallographic studies.

List of Practicals:

1. Using physical properties like hardness, cleavage, streak, lustre etc. to identify important rock forming minerals
2. Studying crystal forms and symmetry elements of cubic crystal system
3. Miller Indices: Learning how to determine and interpret Miller indices to describe crystallographic planes and directions.

References:

1. Klein, C., & Dutrow, B. (2020). *Manual of mineral science* (23rd ed.). Wiley.
2. Nesse, W. D. (2012). *Introduction to mineralogy* (3rd ed.). Oxford University Press.
3. Klein, C., & Hurlbut, C. S., Jr. (1993). *Dana's manual of mineralogy* (21st ed.). Wiley
4. Rhodes, G. (2006). *Crystallography made crystal clear* (3rd ed.). Academic Press.

Nameof Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Petrology	**Course Code**	25GOLM403DS01
Hours per Week	03 Hours	**Credits**	03(L:3, P:0)
Maximum Marks	75 {External(term-end exam)–50}(Internal– 25)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02)and out of which the student will be required to attempt any 07 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each, from all the four units.

CourseLearningOutcomes(CLO):

CLO 1: Students will gain an understanding of the basic principles of petrology, including the classification, formation, and characteristics rocks.

CLO 2: Upon completion of this course, students will be able to identify and classify various igneous rocks based on their mineralogical and geochemical properties.

CLO 3: Students will develop the ability to analyse the processes involved in the formation of sedimentary rocks, including weathering, transportation, and lithification.

CLO 4:Students will be able to evaluate the metamorphic processes that transform pre-existingrocks under different temperature and pressure conditions.

CLO 5: Students will be able to understand the cause of differentiation and various processes responsible for differentiation in magma to yield different result in different conditions.

Unit1: Concept of rocks cycle. Magma: Definition, composition, origin and process of crystallization. Crystallization of uni-component and bi-component magma. Magmatic evolution and differentiation, Bowen's reaction series.

Unit2: Igneous Petrology: Definition and formation of Igneous Rocks.Classification of Igneous Rocks:IUGS classification, Mineralogical classification, Geochemical classification: Alkaline vs. sub-alkaline, acidic vs. basic. Major igneous rock forms: Dikes, sills, laccoliths, batholiths.

Unit3: Sedimentary Petrology: Introduction to Sedimentary Rocks. Sedimentation processes: Weathering, transportation, and deposition, Diagenesis. Classification of Sedimentary Rocks. Sedimentary Structures: Bedding, cross-bedding, ripple marks, graded bedding, Mud cracks, trace fossils. Sedimentary Textures analysis:Grain size, Sorting, Roundness, sphericity and porosity.

Unit4: Metamorphic Petrology: Definition and formation of metamorphic rocks, Factors influencing metamorphism: Temperature, pressure, fluids. Types of Metamorphism. Classification of Metamorphic Rock: Based on texture: Foliated (schist, slate, gneiss) vs. non-foliated (marble, quartzite). Protoliths and metamorphic grade. Metamorphic facies and isograds

References:

1. Winter, J. D. (2010). An Introduction to Igneous and Metamorphic Petrology. Pearson Education.
2. Le Maitre, R. W. (2002). Igneous Rocks: A Classification and Glossary of Terms. Cambridge University Press.
3. Blatt, H., Middleton, G., & Murray, R. (1980). Origin of Sedimentary Rocks. Prentice Hall.
4. Spear, F. S. (1993). Metamorphic Phase Equilibria and Pressure-Tempe

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical(Petrology)	**Course Code**	24GOLM403DS01
Hours per Week	02 Hours	**Credits**	01 (L:0, P:1)
Maximum Marks	25	**Time of Examinations**	1.5 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paper will set by the internal examiner.The distribution of Marks will be as follows:

Marks for Question Paper:	12
Marks for Practical Record Book:	05
Marks for Viva-Voce:	03
Attendance :	05
Total:	25

Course Learning Outcomes (CLO):

CLO 1: Identify and classify common igneous, sedimentary, and metamorphic rocks in hand specimen.
CLO 2: Apply key diagnostic physical properties to differentiate between various rock types.
CLO 3: Assess the mineral composition and texture of rocks and identify their geological significance.
CLO 4: Recognize the effects of weathering in rocks and soil.
CLO 5: Gain the practical skills to conduct field identification of rocks using physical properties

List of Practicals:

1. Observe the texture of the igneous rock—whether it is coarse-grained (phaneritic), fine-grained (aphanitic), glassy, vesicular, or porphyritic.
2. Note the mineral composition and color of the igneous rock to distinguish between felsic (light-colored) and mafic (dark-colored) types.
3. Check for special features in igneous rocks like vesicles (gas bubbles), flow banding, or large crystals in a finer groundmass.
4. Examine the grain size of sedimentary rocks to classify them as fine (shale), medium (sandstone), or coarse (conglomerate).
5. Look at the degree of cementation and hardness in sedimentary rocks to understand their composition and origin.
6. Identify sorting and roundness of grains in sedimentary rocks, which indicate the energy and environment of deposition.
7. Observe the layering or stratification in sedimentary rocks, which is a key feature in distinguishing them from others.
8. Determine the texture of metamorphic rocks—whether it is foliated (slate, schist, gneiss) or non-foliated (marble, quartzite).
9. Analyse the grain size and mineral alignment in metamorphic rocks, especially for foliated varieties, to identify the type and grade of metamorphism.

References:

1. Klein, C., & Philpotts, A. R. (2016). *Petrology: The study of igneous, sedimentary, and metamorphic rocks* (4th ed.). Pearson Education.
2. Bosworth, W., & Kearey, P. (2018). *Petrology handbook: A guide to the identification of rocks*. Wiley-Blackwell.
3. Fairbairn, H. W. (1980). *Handbook of petrology: A guide to the study of rocks in hand specimen*. Cambridge University Press.
4. Winter, J. D. (2010). *Principles of igneous and metamorphic petrology* (2nd ed.). Pearson Education.
5. Best, M. G. (2003). *Igneous and metamorphic petrology* (2nd ed.). Wiley-Blackwell.
6. Blatt, H., Tracy, R. J., & Owens, B. E. (2006). *Petrology: Igneous, sedimentary, and metamorphic* (3rd ed.). W. H. Freeman.
7. Philpotts, A. R., & Ague, J. J. (2009). *Principles of igneous and metamorphic petrology* (2nd ed.). Cambridge University Press.
8. Mason, R. (1981). *Petrology of the igneous and metamorphic rocks* (2nd ed.). George Allen & Unwin.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Structural Geology	**Course Code**	25GOLM404DS01
Hours per Week	02 Hours	**Credits**	02 (L:2, P:0)
Maximum Marks	50 {External (term-end exam)–35} (Internal– 15)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 01)and out of which the student will be required to attempt any 07 questions. In the remaining sections B, C, D and E there will be two questions of 07 marks each, from all the four units.

CourseLearningOutcomes(CLO):

CLO 1: Identify and describe various types of geological structures such as folds, faults, joints, and unconformities in rocks through field observations and hand specimens.

CLO 2: Interpret geological maps and cross-sections to determine the three-dimensional orientation of rock layers and structural features.

CLO 3: Apply principles of stress and strain to understand deformation in rocks and explain the mechanics behind geological structures.

CLO 4: Use stereographic projections and other graphical methods to analyze the orientation and relationships of structural elements.

CLO 5: Integrate field data, laboratory observations, and theoretical knowledge to reconstruct the tectonic history of a region.

Unit1: Introduction to Structural Geology,Concepts of rock deformation: Stress and strain. Concept of dip and strike, outlier and inlier. Defining unconformity, exploring its types, recognition methods, and geological significance.

Unit2:**Folds**: Definition and parts of folds, Geometric and genetic classification of folds, Mechanism and causes of folding in rocks.

Unit3: Faults: Understanding different parts of faults,Geometric and genetic classification of faults. Identification of faults in the field. **Joints:** Definition and classification of joints, mechanism of jointing and significance of joints.

Unit4: Exploring the development mechanisms of foliation and cleavage. Identifying foliations in gneisses and mylonitic zones. Understanding the basic terminology and types of lineations.

References:

1. Davis, G. R. (1984). *Structural Geology of Rocks and Regions*. John Wiley.
2. Billings, M. P. (1987). *Structural Geology* (4th edition). Prentice-Hall.
3. Park, R. G. (2004). *Foundations of Structural Geology*. Chapman & Hall.
4. Pollard, D. D. (2005). *Fundamentals of Structural Geology*. Cambridge University Press.
5. Ragan, D. M. (2009). *Structural Geology: An Introduction to Geometrical Techniques* (4th edition). Cambridge University Press.
6. Twiss, R. J., & Moores, E. M. (2007). *Structural geology* (2nd ed.). W. H. Freeman and Company.
7. Fossen, H. (2016). *Structural geology* (2nd ed.). Cambridge University Press.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical (Structural Geology)	**Course Code**	25GOLM404DS01
Hours per Week	04 Hours	**Credits**	02 (L:0, P:2)
Maximum Marks	50	**Time of Examinations**	03 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paperwill set by the internal examiner.The distribution of Marks will be as follows:

Marks for Question Paper:	33
Marks for Practical Record Book:	07
Marks for Viva-Voce:	05
Attendance :	05
Total:	50

Course Learning Outcomes (CLO):

CLO1: Identify and classify common igneous, sedimentary, and metamorphic rocks in hand specimen.
CLO2: Apply key diagnostic physical properties to differentiate between various rock types.
CLO3: Assess the mineral composition and texture of rocks and identify their geological significance.
CLO4: Recognize the effects of weathering in rocks and soil.
CLO5: Demonstrate the practical skills to conduct field identification of rocks using physical properties

List of Practicals:

1. Learn to operate a compass-clinometer for accurate measurement of geological structures in the field.
2. Measure the strike and dip of planar structures such as bedding planes and foliation surfaces.
3. Practice geological mapping techniques, including recording field observations and structural data on a base map.
4. Construct geological cross-sections from map data to visualize subsurface structures and stratigraphic relationships.
5. Identify and classify different types of folds such as anticlines, synclines, and monoclines in hand specimens and field examples.
6. Interpret various types of faults—normal, reverse, and strike-slip—based on field evidence and map patterns.

References:

1. Billings, M. P. (1972). *Structural geology* (3rd ed.). Prentice-Hall.
2. Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2012). *Structural geology of rocks and regions* (3rd ed.). John Wiley & Sons.
3. Twiss, R. J., & Moores, E. M. (2007). *Structural geology* (2nd ed.). W. H. Freeman and Company.
4. Ramsay, J. G. (1967). *Folding and fracturing of rocks*. McGraw-Hill.
5. Park, R. G. (2004). *Foundations of structural geology*. Chapman & Hall.
6. Pollard, D. D., & Fletcher, R. C. (2005). *Fundamentals of structural geology*. Cambridge University Press.
7. Ragan, D. M. (2009). *Structural geology: An introduction to geometrical techniques* (4th ed.). Cambridge University Press.
8. Fossen, H. (2016). *Structural geology* (2nd ed.). Cambridge University Press.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Palaeontology	**Course Code**	26GOLM405DS01
Hours per Week	02 Hours	**Credits**	02 (L:2, P:0)
Maximum Marks	50 {External (term-end exam)–35} (Internal– 15)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 01)and out of which the student will be required to attempt any 07 questions. In the remaining sections B, C, D and E there will be two questions of 07 marks each, from all the four units.

Course Learning Outcomes (CLO)

CLO 1: Understand the basic concepts of Palaeontology, fossilization processes, geological time scale and the significance of fossils.

CLO 2: Identify and classify major groups of invertebrate fossils based on their morphology and geological distribution.

CLO 3: Describe the evolution and geological significance of vertebrate fossils.

CLO 4: Explain the characteristics and geological significance of Gondwana flora and the fundamentals of Micropalaeontology.

CLO 5: Apply palaeontological knowledge in fossil identification, stratigraphic correlation, petroleum exploration and palaeoenvironmental interpretation.

Unit 1: Introduction to Palaeontology, definition, scope and branches of Palaeontology. Fossils: definition, types and significance. Modes of fossilization and preservation. Index fossils and their significance. Geological Time Scale and evolution of life.

Unit 2: Invertebrate Palaeontology: General characteristics, morphology and geological distribution of Trilobita, Brachiopoda, Mollusca (Bivalvia, Gastropoda and Cephalopoda) and Corals

Unit 3: Vertebrate Palaeontology: Introduction to vertebrate fossils. Evolution of fishes, amphibians, reptiles, birds and mammals. Dinosaurs and their extinction.

Unit 4: Introduction to Palaeobotany. Gondwana flora of India. Introduction to Micropalaeontology and its applications. Applications of fossils in stratigraphy, petroleum exploration and palaeoenvironmental studies.

References:

1. Benton, M. J., & Harper, D. A. T. (2020). *Introduction to Paleobiology and the Fossil Record* (2nd ed.). Wiley-Blackwell.
2. Benton, M. J. (2024). *Vertebrate Palaeontology* (5th ed.). Wiley.
3. Clarkson, E. N. K. (2013). *Invertebrate Palaeontology and Evolution* (4th ed.). Wiley-Blackwell.
4. Jain, P. C., & Anantharaman, M. S. (2022). *Palaeontology (Palaeobiology): Evolution and Animal Distribution* (12th ed.). Vishal Publishing Co.
5. Jain, P. C. *Fundamentals of Palaeontology*. CBS Publishers & Distributors.
6. Prothero, D. R. (2020). *Bringing Fossils to Life: An Introduction to Paleobiology* (4th ed.). Columbia University Press.
7. Stewart, W. N., & Rothwell, G. W. (2010). *Paleobotany and the Evolution of Plants* (2nd ed.). Cambridge University Press.
8. Brasier, M. D. (1980). *Microfossils*. George Allen & Unwin.
9. Krishnan, M. S. (2018 Reprint). *Geology of India and Burma* (6th ed.). CBS Publishers & Distributors. Foote, M., & Miller, A. I. (2007). *Principles of Paleontology* (3rd ed.). W. H. Freeman.
10. Raup, D. M., & Stanley, S. M. (1978). *Principles of Paleontology* (2nd ed.). W. H. Freeman.
11. Prothero, D. R. (2013). *Evolution: What the Fossils Say and Why It Matters* (2nd ed.). Columbia University Press.
12. Benton, M. J. (2015). *When Life Nearly Died: The Greatest Mass Extinction of All Time* (2nd ed.). Thames & Hudson.
13. Doyle, J. A., & Bennett, K. D. (Eds.). (1995). *Palynology: Principles and Applications*. American Association of Stratigraphic Palynologists Foundation.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical (Palaeontology)	**Course Code**	26GOLM405DS01
Hours per Week	04 Hours	**Credits**	02 (L:0, P:2)
Maximum Marks	50	**Time of Examinations**	3 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paperwill set by the internal examiner.The distribution of Marks will be as follows:

Marks for Question Paper:	33
Marks for Practical Record Book:	07
Marks for Viva-Voce:	05
Attendance :	05
Total:	50

Course Learning Outcomes (CLO):

CLO 1: Identify and classify important invertebrate fossils using their external morphology and diagnostic characters.
CLO 2: Identify important vertebrate fossils, Gondwana plant fossils and common microfossils using hand specimens, charts and models.
CLO 3: Determine the geological age and stratigraphic significance of important index fossils.
CLO 4: Interpret the geological significance of fossils in stratigraphic correlation and palaeoenvironmental studies.
CLO 5: Demonstrate practical skills in fossil identification, classification and interpretation using hand specimens, charts and models.

1. Megascopic study and description of invertebrate fossils based on external morphology, symmetry, ornamentation and preservation.
2. Identification and classification of important fossil groups including Trilobita, Brachiopoda, Corals, Bivalvia, Gastropoda and Cephalopoda using hand specimens.
3. Identification of vertebrate fossils from hand specimens, casts and museum models with emphasis on diagnostic skeletal features.
4. Study of Gondwana plant fossils and identification of important genera using hand specimens, photographs and charts.
5. Microscopic study of common microfossils (Foraminifera, Ostracoda and Diatoms) using prepared slides and photomicrographs.
6. Identification of index fossils and determination of their geological age and stratigraphic range using standard geological charts.

References:

1. Clarkson, E. N. K. (2013). *Invertebrate Palaeontology and Evolution* (4th ed.). Wiley-Blackwell.
2. Benton, M. J. (2024). *Vertebrate Palaeontology* (5th ed.). Wiley.
3. Jain, P. C., & Anantharaman, M. S. (2022). *Palaeontology (Palaeobiology): Evolution and Animal Distribution* (12th ed.). Vishal Publishing Co.
4. Brasier, M. D. (1980). *Microfossils*. George Allen & Unwin.
5. Stewart, W. N., & Rothwell, G. W. (2010). *Paleobotany and the Evolution of Plants* (2nd ed.). Cambridge University Press.
6. Prothero, D. R. (2020). *Bringing Fossils to Life: An Introduction to Paleobiology* (4th ed.). Columbia University Press.
7. Jain, P. C. *Fundamentals of Palaeontology*. CBS Publishers & Distributors.
8. Traverse, A. (2007). *Paleopalynology* (2nd ed.). Springer.
9. Armstrong, H. A., & Brasier, M. D. (2005). *Microfossils* (2nd ed.). Blackwell Publishing.
10. Brenchley, P. J., & Harper, D. A. T. (2006). *Palaeoecology: Ecosystems, Environments and Evolution*. Chapman & Hall.
11. Briggs, D. E. G., & Crowther, P. R. (Eds.). (2008). *Palaeobiology II*. Wiley-Blackwell.
12. Jain, S. (2017). *Fundamentals of Palaeontology: Evolution of Life Through Time*. Springer.

Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Stratigraphy	**Course Code**	26GOLM405DS01
Hours per Week	02 Hours	**Credits**	02 (L:2, P:0)
Maximum Marks	50 {External (term-end exam)–35} (Internal– 15)	**Time of Examinations**	03 Hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabus. The candidate must attempt five questions in all selecting one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 01)and out of which the student will be required to attempt any 07 questions. In the remaining sections B, C, D and E there will be two questions of 07 marks each, from all the four units.

Course Learning Outcomes (CLO)

CLO 1: Understand the principles, terminology and methods used in Stratigraphy and the Geological Time Scale.
CLO 2: Describe the Precambrian, Palaeozoic, Mesozoic and Cenozoic stratigraphic succession of India.
CLO 3: Identify the characteristic lithology, fossil content and geological significance of major stratigraphic units of India.
CLO 4: Correlate geological formations using lithostratigraphic, biostratigraphic and chronostratigraphic principles.
CLO 5: Apply stratigraphic knowledge in geological mapping, mineral and petroleum exploration, and interpretation of Earth's geological history.

Unit 1: Introduction to Stratigraphy, definition, scope and branches of Stratigraphy. Principles of Stratigraphy. Geological Time Scale. Lithostratigraphy, Biostratigraphy and Chronostratigraphy. Applications of Stratigraphy.

Unit 2: Introduction to Indian Stratigraphy. Archaean and Dharwar Supergroup. Aravalli and Delhi Supergroups. Cuddapah and Vindhyan Supergroups. Palaeozoic succession of India.

Unit 3:. Mesozoic stratigraphy of India: Gondwana Supergroup.Marine sequences of Spiti and Kashmir, Jurassic succession of Kachchh. Cretaceous succession of Trichinopoly and Ariyalur.

Unit 4: Cenozoic stratigraphy of India: Deccan Traps and their geological significance. Himalayan Stratigraphy. Siwalik Group. Indo-Gangetic Alluvium and Quaternary deposits of India.

References:

1. Boggs, S. (2014). *Principles of Sedimentology and Stratigraphy* (5th ed.). Pearson.
2. Ravindra Kumar. (2018). *Fundamentals of Historical Geology and Stratigraphy*. New Age International Publishers.
3. Wadia, D. N. (2017 Reprint). *Geology of India*. McGraw-Hill Education.
4. Krishnan, M. S. (2018 Reprint). *Geology of India and Burma* (6th ed.). CBS Publishers & Distributors.
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6. Doyle, P., & Bennett, M. R. (1998). *Unlocking the Stratigraphical Record: Advances in Modern Stratigraphy*. John Wiley & Sons.
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9. Murphy, M. A., & Salvador, A. (1999). *International Stratigraphic Guide: An Abridged Version*. Episodes, International Union of Geological Sciences.
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Name of Program	UG Physical Sciences Program (Geology)	**Program Code**	
Name of the Course	Practical (Stratigraphy)	**Course Code**	26GOLM405DS01
Hours per Week	04 Hours	**Credits**	02 (L:0, P:2)
Maximum Marks	50	**Time of Examinations**	03 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paperwill set by the internal examiner.The distribution of Marks will be as follows:

Marks for Question Paper:	33
Marks for Practical Record Book:	07
Marks for Viva-Voce:	05
Attendance :	05
Total:	50

Course Learning Outcomes (CLO):

CLO 1: Identify the major stratigraphic units of India using geological maps, stratigraphic columns and lithological successions.

CLO 2: Interpret the Geological Time Scale and correlate major stratigraphic successions of India.

CLO 3: Identify characteristic lithological and palaeontological features of important stratigraphic units.

CLO 4: Develop the ability to prepare and interpret stratigraphic columns and geological cross-sections.

CLO 5: Demonstrate practical skills in geological mapping, stratigraphic correlation and interpretation of geological history.

List of Practicals:

1. Study and interpretation of the Geological Time Scale and major geological eras, periods and epochs.
2. Preparation and interpretation of generalized stratigraphic columns showing the major geological systems of India.
3. Identification and correlation of major stratigraphic units using geological maps, stratigraphic charts and lithological columns.
4. Megascopic study of characteristic lithologies of important Indian stratigraphic units including Archaean, Dharwar, Aravalli, Delhi, Cuddapah, Vindhyan, Gondwana, Deccan Traps and Siwalik Group.
5. Study and identification of characteristic fossils of major geological systems and their use in age determination and stratigraphic correlation.
6. Preparation and interpretation of geological cross-sections showing the stratigraphic succession of selected regions of India.
7. Preparation of stratigraphic correlation charts and interpretation of the geological history of selected Indian sedimentary basins.

References:

1. Boggs, S. (2014). *Principles of Sedimentology and Stratigraphy* (5th ed.). Pearson.
2. Brookfield, M. E. (2004). *Principles of Stratigraphy*. Blackwell Publishing.
3. Miall, A. D. (2016). *Stratigraphy: A Modern Synthesis*. Springer.
4. Ravindra Kumar. (2018). *Fundamentals of Historical Geology and Stratigraphy*. New Age International.
5. Gradstein, F. M., Ogg, J. G., Schmitz, M. D., & Ogg, G. M. (2020). *Geologic Time Scale 2020*. Elsevier.
6. Wadia, D. N. (2017 Reprint). *Geology of India*. McGraw-Hill Education.
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8. Pascoe, E. H. (2019 Reprint). *A Manual of the Geology of India and Burma*. CBS Publishers & Distributors.
9. Compton, R. R. (1985). *Geology in the Field*. John Wiley & Sons.
10. Lahee, F. H. (1961). *Field Geology*. McGraw-Hill Book Company.
11. Lisle, R. J., Brabham, P., & Barnes, J. W. (2011). *Basic Geological Mapping* (5th ed.). Wiley-Blackwell.
12. Bennison, G. M. (2002). *An Introduction to Geological Structures and Maps* (7th ed.). Hodder Arnold.
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15. Geological Survey of India. *Geological Maps of India and Explanatory Memoirs*. Geological Survey of India.