

**CBCS SYLLABUS
FOR
THREE YEARS UNDER-GRADUATE COURSE
IN
GEOLOGY (PROGRAMME)
(w.e.f. 2017)**



**BANKURA UNIVERSITY
BANKURA, WEST BENGAL, PIN 722155**



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1. Scheme for CBCS Curriculum for Pass Course

All Pass courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from three disciplines of choice including Geology as one of the disciplines. Student will also select 2 elective courses each from discipline of choice including Geology as one of the disciplines. Student may also choose Skill Enhancement courses in Geology.

Abbreviations Used:

SP= Science Programme, GEL= Geology, ACSHP= Arts Commerce Science Honours Programme, AECC= Ability Enhancement Compulsory Course, C= Core Course, DSE= Discipline Specific Elective, ESE= End-Semester Examination, GE= Generic Elective, IA= Internal Assessment, Lec.= Lecture, Prc.=Practical, SEC= Skill Enhancement Course, and Tu.= Tutorial

1.1 Credit distribution across courses

Course Type		Total Papers	Credits	
			Theory + Practical	Theory* + Tutorials
Core Courses (CC)	4 papers each from 3 disciplines of choice	12	12*4 =48 12*2 =24	12*5 =60 12*1=12
Elective Courses (DSE)	2 papers each from 3 discipline of choice including interdisciplinary papers	6	6*4=24 6*2=12	6*5=30 6*1=6
Ability Enhancement Language Courses (AECC)		1 1	1*4=4 1*2=2	1*4=4 1*2=2
Skill Enhancement Courses (SEC)		4	4*2=8	4*2=8
Totals		24	122	122

*Tutorials of 1 Credit will be conducted in case there is no practical component

**1.2 Semester-wise distribution of courses and credit (Geology as one of the disciplines)**

Courses/ (Credits)	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total No. of Courses	Total Credit
CC-1,2,3 (6)	3 (1A*, 2A, 3A)	3 (1B*, 2B, 3B)	3 (1C*, 2C, 3C)	3 (1D*, 2D, 3D)			12	72
DSE-1,2,3 (6)					3 (1A*, 2A, 3A)	3 (1B*, 2B, 3B)	6	36
AECC (2)	1	1					2	06
SEC (2)			1*	1*	1*	1*	4	08
Total no. of courses per Sem.	4	4	4	4	4	4	24	
Total Credit per Sem.	20	20	20	20	20	20		122

***May be opted from courses of Geology**



2. Detail course Structure

The details for core courses, elective courses and skill enhancement courses in Geology is given below:

SEMESTER-I

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP/GEL/101/CT-1A & SP/GEL/101/CP-1A	Introduction to Geology	4	10	25	35	4	0	0
	Introduction to Geology Lab	2	0	15	15	0	0	4
102/C-2A	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
103/C-3A	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 lab	2	0	15	15	0	0	4
ACSHP/104/AECC-1	Environmental Studies	4	10	40	50	4	0	0
Total in Semester-I		22	40	160	200			

SEMESTER-II

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP /GEL/201/C-T1B & SP /GEL/201/C-P1B	Minerology and Petrology	4	10	25	35	4	0	0
	Minerology and Petrology Lab	2	0	15	15	0	0	4
202/C-2B	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
203/C-3B	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 Lab	2	0	15	15	0	0	4
ACSHP/204/AECC-2	English/MIL/Hindi	2	10	40	40	2	0	0
Total in Semester- II		20	40	190	160			

**SEMESTER-III**

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP/GEL/301/C-T1C & SP /GEL/301/C-P1C	Earth External Processes	4	10	25	35	4	0	0
	Earth External Processes Lab	2	0	15	15	0	0	4
302/C-2C	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
303/C-3C	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 Lab	2	0	15	15	0	0	4
SP /GEL/304/SEC-1	Field Geology-I	2	10	40	50	0	0	4
Total		20	40	160	200			

SEMESTER-IV

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP /GEL/401/C-T1D & SP /GEL/401/C-P1D	Natural Resources	4	10	25	35	4	0	0
	Natural Resources Lab	2	0	15	15	0	0	4
402/C-2D	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
403/C-3D	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 Lab	2	0	15	15	0	0	4
SP /GEL/404/SEC-2	Field Geology-II	2	10	40	50	0	0	4
Total		20	40	160	200			

**SEMESTER-V**

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP /GEL/501/DSE-1TA & SP /GEL/501/DSE-1PA	Introduction to Fuel Geology/ Mineral Exploration	4	10	25	35	4	0	0
	Introduction to Fuel Geology Lab/ Mineral Exploration Lab	2	0	15	15	0	0	4
502/DSE-2B	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
503/DSE-3B	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 Lab	2	0	15	15	0	0	4
SP /GEL/504/SEC-3	Field Geology-III	2	0	15	15	0	0	4
Total		20	40	160	200			

SEMESTER-VI

COURSE CODE	COURSE TITLE	CREDIT	MARKS			No. of hours		
			IA	ESE	TOTAL	Lec	Tu	Pr
SP /GEL/601/DSE-1TB & SP /GEL/601/DSE-1PB	Basics of River Science/ Geotectonics	4	10	25	35	4	0	0
	Basics of River Science Lab/ Geotectonics Lab	2	0	15	15	0	0	4
602/DSE-2B	Discipline-2	4	10	25	35	4	0	0
	Discipline-2 Lab	2	0	15	15	0	0	4
603/DSE-3B	Discipline-3	4	10	25	35	4	0	0
	Discipline-3 Lab	2	0	15	15	0	0	4
SP /GEL/604/SEC-4	Field Geology-IV	2	0	15	15	0	0	4
Total		20	40	160	200			

**2.1 Choices for Core Subjects**

Core subjects (to be chosen 4 subjects out of the following)			
Introduction to Geology	Mineralogy and Petrology	Earth External Processes	Natural Resources

2.2 Choices for Discipline Specific Electives

Discipline Specific Elective (to be chosen 2 subjects out of the following)			
Introduction to Fuel Geology	Mineral Exploration	Basics of River Science	Geotectonics

2.3 Choices for Skill Enhancement Courses

Skill Enhancement Course-1	Field Geology I
Skill Enhancement Course-2	Field Geology I
Skill Enhancement Course-3	Field Geology III
Skill Enhancement Course-4	Field Geology IV



3. Core Subjects Syllabus

3.1 Core T1 – Introduction to Geology

4 Credits

Unit 1: Introduction

Geology- scope, sub-disciplines and relationship with other branches of sciences

Unit 2 Origin of earth

1. Earth in the solar system, origin
2. Earth's size, shape, mass, density
3. Solar System- Introduction to Various planets - Terrestrial Planets and Jovian Planets

Unit 3: Solid Earth, Hydrosphere, Atmosphere and Biosphere

1. Mechanical layering of the Earth: Lithosphere, asthenosphere, mantle and core
2. Earthquake and earthquake belts: Seismic waves and internal constitution of the Earth
3. Volcanoes and volcanism, distribution of volcanoes
4. Concept of isostasy
5. Formation of core, mantle, crust, atmosphere, Hydrosphere and Biosphere.

Unit 4: Plate Tectonics

1. Fundamental Earth process: Plate tectonics. Plates and Plate boundaries.
2. Origin of oceans, continents, mountains and rift valleys

Unit 5: Earth's Surface Processes

1. Weathering and Erosion.
2. Landforms in deserts, glaciated region and river valleys

Unit 6: Age of Earth

Age of the earth; Radioactivity and its application in determining the age of the Earth, rocks, minerals and fossils

Reference Books

- Holmes' Principles of Physical Geology. 1992. Chapman & Hall.
Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.
Gross, M.G., 1977. Oceanography: A view of the Earth, Prentice Hall.

3.2 Core P1 – Introduction to Geology Lab

Credits 2

List of Practical

1. Study of topographic sheets and description of physiographic features of an area.
2. Study of geological maps with simple outcrop patterns
3. Study of distribution of major lithostratigraphic units on the map of India



4. Study of important rocks, minerals and fossils (the items may be fixed by the department concern)

3.3 Core T2 Minerology and Petrology

Minerology and Petrology

4 Credits

Unit 1

1. Minerals-Definitions, Physical properties of minerals
2. Chemical classification of minerals.
3. Internal structure of minerals
4. Atomic structure of silicate minerals

Unit 2

1. Mineralogical Composition of common crustal rocks
2. Mineralogical Composition of mantle.

Unit 3

1. Nature of light and optical behaviour of crystals
2. Classification of minerals on the basis of optical character

Unit 4

1. Rocks-Definitions and types, rock; Processes of formation of Igneous rocks, sedimentary rocks and metamorphic rocks
2. Classification of Igneous rocks (Hatch, Hatch and Wells and IUGS), sedimentary rocks (Folk) and metamorphic rocks. Concept of grade in metamorphic rocks

Reference Books

- Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts, Cambridge University Press, 2013.
- Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and company, New York.

3.4 Core P2 – Minerology and Petrology Lab

Minerology and Petrology

2 Credits

List of Practical

1. Study of physical properties of common rock forming minerals
2. Study of optical properties of common rock forming minerals
3. Study of common sedimentary, igneous and metamorphic rocks in hand samples
4. Study of common sedimentary, igneous and metamorphic rocks under microscope



3.5 Core T3 – Earth external processes

Earth external processes

4 Credits

Unit 1

1. Introduction to earth surface processes
2. Historical development in concepts, terrestrial relief, scales in geomorphology,

Unit 2

1. Energy flow and relative energy of surface processes.
2. Weathering and formation of soils, Processes of formation of important landforms on Earth.

Unit 4

1. Controlling factors (tectonics, climate, sea level changes and anthropogenic) of surface processes
2. Climate change and geomorphic response of fluvial systems of arid and humid regions
Geomorphic response to tectonics, sea level/base level change, anthropogenic affects

Unit 5

1. Surface processes and natural hazards
2. Applied aspects of geomorphology

Reference Books

- Alien, P.A., 1997. Earth Surface Processes, Blackwell publishing.
- Bloom, A.L., 1998. Geomorphology: A Systematic Analysis of Late Cenozoic Landforms, Pearson Education.
- Bridge, J.S. and Demicco, R.V., 2008. Earth Surface Processes, Landforms and Sediment Deposits, Cambridge University Press.
- Esterbrook, D.J., 1992. Surface Processes and Landforms, MacMillan Publ.
- Kale, V.S. and Gupta A 2001 Introduction to Geomorphology, Orient Longman Ltd.
- Leeder, M. and Perez-Arlucea M 2005 Physical processes in earth and environmental sciences, Blackwell' publishing.
- Summerfield M A 1991Globe Geomorphology Prentice Hall.
- Willcock, P.R., Iverson R M (2003) Prediction in geomorphology ' AGU Publication.

3.6 Core P3 – Earth external processes Lab

Earth external processes

2 Credits



List of Practical

1. Study and interpretations of different landforms on maps
2. Projection of major element data on Harker's diagram to characterize magmatic differentiation
3. Study of trace elements through a) Projection of chondrite/primitive normalized trace elements to characterize sources b) Projection of trace elements on tectonic discrimination diagrams
4. Problems on isostasy

3.7 Core T4 – Natural Resources

Natural Resources

4 Credits

Unit 1: Earth Resources

1. Resource reserve definitions; mineral, energy and water resources
2. A brief overview of classification of mineral deposits with respect to processes of formation

Unit 2: Definition of Energy: Primary and Secondary Energy

1. Difference between Energy, Power and Electricity
2. Renewable and Non-Renewable Sources of Energy
3. The concept and significance of Renewability: Social, Economic, Political and Environmental Dimension of Energy

Unit 3: Major Types and Sources of Energy

1. Resources of Natural Oil and Gas
2. Coal and Nuclear Minerals
3. Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy

Unit 4: Ground Water, Hydropower, Solar power

1. Ground water resources in India and its role in economic development of the country
2. Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells.

Reference Books

- Energy and the Environment by Fowler, J.M 1984. McGraw-Hill
- Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.
- Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer
- Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.
- Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

3.8 Core P4 – Natural Resources Lab



Natural Resources

2 Credits

List of Practical

1. Study of coal in Hand specimen
2. Plotting of major Indian oil fields on map of India
3. Problems related to assessment of possible oil exploration site from geological maps and sections.
4. Construction of cross section of mineral deposits from maps and drill hole data.
5. Estimation of reserves.
6. Preparation and interpretation of depth to water level maps and water level contour maps

4. Department Specific Electives Subjects Syllabus

4.1 DSE T1 – Introduction to Fuel Geology

Introduction to Fuel Geology

4 Credits

Unit 1: Energy Resources

1. Different Sources of energy: Global and Indian scenario

Unit 2: Coal

1. Definition and origin of Coal
2. Basic classification of coal.
3. Fundamentals of Coal Petrology - Introduction to lithotypes, microlithotypes and macerals in coal
4. Proximate and Ultimate analyses
5. Major coal basins of India

Unit 3: Coal as a fuel

1. Concept of clean coal technology
2. Coal Bed Methane (CBM): global and Indian scenario
3. Underground coal gasification
4. Liquefaction of coal

Unit 4: Petroleum

1. Chemical composition and physical properties of crudes oil
2. Origin and migration of petroleum
3. Kerogen: Maturation of kerogen; Biogenic and Thermal effect

Unit 5: Petroleum Reservoirs and Traps

1. Reservoir rocks: general attributes and petrophysical properties.
2. Cap Rocks: definition and general properties



3. Hydrocarbon traps: definition, Classification of hydrocarbon traps - structural, stratigraphic and combination

- a. Time of trap formation and time of hydrocarbon accumulation.
- b. Petroliferous basins of India

Unit 6: Other fuels

1. Nuclear Fuel
2. Gas Hydrate

Reference Books

- Chandra D. (2007). Chandra's Textbook on applied coal petrology. Jijnasa Publishing House.
- Shelly R. C. (2014). Elements of Petroleum geology: Third Edition, Academic Press
- Bjorlykke, K. (1989). Sedimentology and petroleum geology. Springer-Verlag.
- Bastia, R., & Radhakrishna, M. (2012). Basin evolution and petroleum prospectively of the continental margins of India (Vol. 59). Newness.

4.2 DSE P1 – Introduction to Fuel Geology Lab

Introduction to Fuel Geology

2 Credits

List of Practical

1. Study of hand specimens of coal
2. Reserve estimation of coal
3. Section correlation and identification of hydrocarbon prospect
4. Panel and Fence diagrams

4.3 DSE T2 – Mineral Exploration

Mineral Exploration

4 Credits

Unit 1: Mineral Resources

Resource: Definitions, Mineral resources in industries – historical perspective and present scenario, classification of mineral deposits with respect to processes of formation; exploration strategies.

Unit 2: Prospecting and Exploration

1. Principles of mineral exploration
2. Prospecting and exploration: conceptualization, methodology and stages, Sampling, subsurface sampling including pitting, trenching and drilling
3. Geochemical exploration
4. Outline of exploration techniques for ferrous and non-ferrous metals, limestone and coal and petroleum

**Unit 3: Evaluation of data**

Evaluation of sampling data - Mean, mode, median, standard deviation and variance

Unit 4: Drilling and Logging

1. Core and non-core drilling
2. Planning of bore holes and location of boreholes on ground Core-logging

Unit 5: Reserve estimations and Errors

1. Principles of reserve estimation, Factors affecting reliability of reserve estimation
2. Reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks)
3. Regular and irregular grid patterns
4. Statistics and error estimation

Reference Books

- Clark, G.B. 1967. Elements of Mining. 3rd Ed. John Wiley & Sons.
- Arogyaswami, R.P.N. 1996 Courses in Mining Geology. 4th Ed. Oxford-IBH.
- Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing.

4.4 DSE P2 – Mineral Exploration Lab**Mineral Exploration****2 Credits****List of Practical**

1. Identification of anomaly: Gravity and Magnetic
2. Concept of weighted average in anomaly detection
3. Geological cross-section
4. Models of reserve estimation

4.5 DSE T3 – Basics of River Science**Basics of River Science****4 Credits****Unit 1: Stream hydrology**

1. Basic stream hydrology
2. Physical properties of water, sediment and channel flow
3. River discharge

Unit 2: River basin

1. Sediment source and catchment erosion processes Sediment load and sediment yield
2. Sediment transport processes in rivers
3. Erosion and sedimentation processes in channel.



Unit 3: Drainage

1. Drainage network
2. Evolution of drainage network in geological time scale.

Unit 4: Rivers in time and space

1. River diversity in space, Patterns of alluvial rivers - braided, meandering and anabranching channels, Dynamics of alluvial rivers
2. Channel patterns in stratigraphic sequences

Unit 5: Channels and Landscapes

1. Bedrock channels, Bedrock incision process
2. River response to climate, tectonics and human disturbance
3. Bedrock channel processes and evolution of fluvial landscapes.

Reference Books

- Davies, T. (2008) Fundamentals of hydrology. Routledge Publications.
- Knighton, D. (1998) Fluvial forms and processes: A new perspective. Amold Pubs.
- Richards. K. (2004) Rivers: Forms and processes in alluvial channels. Balckburn Press.
- Bryirely and Fryirs (2005) Geomorphology and river management. Blackwell Pub.,
- Julien, P.Y. (2002) River Mechanics. Cambridge University Press.
- Robert, A. (2003) River Processes: An introduction to fluvial dynamics. Arnold Publications.
- Vanoni, V.A. (2006) Sedimentation Engineering. ASCE Manual, Published by American Society of Civil Engineering,
- Tinkler, K.J., Wohl, E.E. (eds.) 1998. Rivers over rock. American Geophyscial Union Monograph, Washington, DC.

4.6 DSE P3 – Basics of River Science Lab

Basics of River Science

2 Credits

List of Practical

1. Stream power calculation, Longitudinal profile analysis
2. Study of drainage pattern

4.7 DSE T4 –Geotectonics

Geotectonics

4 Credits

Unit 1: Introduction

1. Definition. Continents and oceans. Continental and oceanic crust. Internal processes of earth
2. Concept of lithosphere and asthenosphere. Physical character of lithosphere and asthenosphere. Concept of plate.



3. Concept of hot spot and mantle plume. Ophiolites. Palaeomagnetism.

Unit 2: Plate and Plate boundaries

1. Plates: Physical character of plates. Macro and micro plates.
2. Plate boundaries: types, character, Identification of boundaries. Movement of plates along boundaries. Plate velocities.
3. Volcanic arcs, island arcs, trenches, accretionary prisms, oceanic ridges, transform faults. Magmatism in oceanic ridges and in subduction zones

Unit 3: Continental Drift, Sea floor spreading and Plate tectonics

1. Wegner Continental drifts hypothesis and its evidences. Continental position in the past
2. Sea-floor spreading process and its evidences.
3. Plate tectonics model and its evidences. Distribution of plates in the Earth

Unit 4: Plate Motion

1. Palaeomagnetism and motion of plates
2. Driving mechanisms of plates. Plate tectonics and mantle convection.
3. Supercontinents and their breakup and assembly. Wilson cycle

Reference Books

- Turcotte, D.L. and Schubert, G. Geodynamics. Second Edition. Cambridge
- Kearey, p., Klepeis, K. A., and Vine, F. J. (2009). Global Tectonics. Third edition. Wiley-Blackwell, Oxford.

4.8 DSE P4 – Geotectonics Lab

2 Credits

1. Position of Indian sub-continent during different geological times between break-up of Gondwanaland and formation of the Himalayas.
2. Different stages of Atlantic Ocean formation with respect to continental rift system.
3. Distribution of volcanoes along Ring of Fire in Pacific Ocean.
4. Schematic drawings of different stages of ocean-continent collision and continent-continent collision.

5. Skill Enhancement Course

5.1 SEC T1 – Field Geology I

Field Geology I - Basic Field Training

2 Credits

Unit 1

Topographic sheet: Methods of naming. Features, scale. Map reading.

Unit 2



1. Use of topographic sheets in field. Marking location in topographic sheet using physical features and bearing.
2. Use of GPS in field.
3. Distance, height and pace approximation in field.

Unit 3

1. Identification of rock types.
2. Identification of sedimentary and tectonic structures in field.

Unit 4

1. Clinometer and Brunton compass: Use of the instruments in measuring geological data in field. Techniques of measurement of orientation data in field.
2. Litholog measurement

Unit 5

1. Recording field data in maps and notebooks.
2. Report writing.

5.2 SEC T2 - Field Geology II

Field Geology II - Geological Mapping and Structural Geology Field **2 Credits**

Unit 1

Preparation of a geological map of a small area with homoclinal or gently folded beds.

Unit 2

Stereographic plots of orientation data and their interpretation.

5.3 SEC T3 – Field Geology III

Field Geology III- Stratigraphy and Palaeontology-related field **2 Credits**

List of Visits

1. Preparation of a Geological map of a small area with folded/faulted beds.
2. Interrelation between different structural elements and their interpretations.

5.4 SEC T4 - Field Geology IV

Field Geology IV - Himalayan Geology Field **2 Credits**

List of Visits

1. Field training in a sedimentary basin. Documentation of stratigraphic details in the field.



2. Collection of sedimentological, and stratigraphical and paleontological details and their representation.

Or

1. Preparation of a geological transect map in the Himalayas

Or

1. Visit to an underground or Open cast mine

2. Underground mapping/Bench mapping Study

Or

1. Geological mapping of a project site (Dam sites, tunnel, etc).

2. Identification of environmental problems of a project site and remedial measures to be taken.