BANKURA UNIVERSITY

(West Bengal Act XIX of 2013- Bankura University Act, 2013)

Main Campus, Bankura Block-II, P.O.: Purandarpur, Dist.: Bankura, Pin- 722155, West Bengal

Office of the Secretary

Faculty Council for Undergraduate Studies

Ref: BKU/FCUG/296/2026 Date: 17/11/2026

NOTIFICATION

As directed, the undersigned is pleased to inform all concerned that Bankura University has initiated the process to implement New Curriculum and Credit Framework for Undergraduate Programme, UGC 2022 (as per NEP 2020) for 4-years Undergraduate programme with Geology as Major, Minor etc. from the academic session 2023-2024. The syllabus as framed / drafted and partially implemented deserves to be analysed after receiving feedback from different stakeholders. As an important corollary to the process, a workshop will be organized on the date mentioned herewith to get the feedback from the stakeholders. Present Students, Alumni, Guardians, Academicians and other stakeholders related to the specific programme/course are requested for their kind participation in the workshop and to present their views/ observations, etc. The stakeholders may go through the draft syllabus attached herewith and convey their observations to the office of the undersigned on ugsecretaryoffice@bankurauniv.ac.in within seven days from the date of publication of this notice.

Date: 28/11/2026

Time: 8 PM

Google Meet joining link: https://meet.google.com/mbn-gjgi-wsq

Sd/-
Dr. Arindam Chakraborty
Secretary
Faculty Council for Undergraduate Studies

Ref: BKU/FCUG/296(6)/2026 Date: 17/11/2026

1. Registrar (Addl. Charge), Bankura University.
2. Dean (Officiating), Faculty Council of P.G. Studies in Arts, Science etc. Bankura University.
3. Chairperson / Convenor, Undergraduate Board of Studies in Geology, Bankura University with request for necessary action.
4. System Administrator, Bankura University with request to upload this in website.
5. Secretary, Hon'ble Vice Chancellor, Bankura University.
6. Guard File.

Sd/-
Dr. Arindam Chakraborty
Secretary
Faculty Council for Undergraduate Studies

CURRICULUM AND CREDIT FRAMEWORK FOR FOUR-YEAR UNDERGRADUATE PROGRAMMES OF GEOLOGY WITH A SINGLE MAJOR

(*w.e.f. A.Y. 2023-2024*)

BANKURA UNIVERSITY
BANKURA, WEST BENGAL, PIN 722155

Indrani Mondal

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1. Introduction

One of the major initiatives of University Grants Commission (UGC) for quality improvement in higher education system is the curriculum revision. National Education Policy (NEP) 2020 recognizes the important role of higher education in promoting human as well as societal well-being and in developing India. NEP recommends that the undergraduate (UG) programmes will be of either 3 or 4-year duration with multiple entry and exit options within this period. The recommended programme certifications are: UG certificate after completing 01 (one) year, or a UG diploma after 02 (two) years of study; or a bachelor degree after 03 (three) years and a bachelor degree (with honours/ honours with research) after 04 (four) years.

In accordance with the NEP 2020, the UGC has formulated a new student-centric Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject/field of their own interest.

Geology as a discipline falls within the special category of science with a multidisciplinary approach. The present syllabus for geology at undergraduate level under the CBCS has been framed in compliance with curriculum and credit framework given by the UGC following NEP. The goal of the syllabus is to equip students with the fundamental knowledge of the diverse fields of earth science. The geology programmes integrate field trips with classroom learning to give the hands-on experience, which is often required to succeed. These opportunities develop the technical skills using measuring instruments and laboratory equipment. Thus, more emphasis has been given on skill enhancement courses.

The ultimate goal of the syllabus is to equip students with knowledge, skills, values, attitudes, leadership readiness/qualities and learning. Hence, at the end, the students will be able to secure very good opportunities as per their own choices.

Abbreviations used:

AEC- Ability Enhancement Courses (e.g., English language, MIL etc.); DSC - Department Specific Core Course; DSE – Department Specific Electives; ESE – End Semester Examination; IA – Internal Assessment; L – Lecture, P/Pr.- Practical; SEC – Skill Enhancement Course; T – Tutorial Th. – Theoretical; VAC – Value-Added Course (e.g., Environmental study, Understanding India, Health and Wellness etc.).

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2. Semester-wise credit distribution in different UG programmes of Geology with a single major

Year	Semester	Category of Courses (Credit of each course** x No. of courses)								Semester-wise total credits (No. of courses)
		Major (MJC)	Minor (MN)	Multi-disciplinary (MD)	Skill Enhancement (SEC)	Ability Enhancement (AEC)	Value-added (VAC)	Internship/ Apprenticeship (INT)	Research Project/ Dissertation (RP)	
1st	I	(4x1) = 4	(4x1) = 4	(3x1) = 3	(3x1) = 3	(2x1) = 2	(4x1) = 4		--	**20**(6)
	II	(4x1) = 4	(4x1) = 4	(3x1) = 3	(3x1) = 3	(2x1) = 2	(4x1) = 4		-	**20**(6)
	Total credits (courses**) up to 2nd Semester**	**8**(2)	**8**(2)	**6**(2)	**6**(2)	**4**(2)	**8** (2)	**4** (2)##		**40** (12)
2nd	III	(4x2) = 8	(4x1) = 4	(3x1) = 3	(3x1) = 3	(2x1) = 2	-		-	**20**(6)
	IV	(4x4) = 16	(4x1) = 4	-		(2x1) = 2	-		-	**22**(6)
	Total credits (courses**) up to 4th Semester**	**32** (8)	**16** (4)	**9**(3)	**9**(3)	**8**(4)	**8**(2)	**4** (2)##	-	**82** (24)
3rd	V	(4x4) = 16	(4x1) = 4	-	-	-	-	(2x1) = 2	-	**22** (6)
	VI	(4x4) = 16	(4x1) = 4	-	-	-	-	-		**20** (5)
	Total credits (courses**)up to 6th Semester**	**64**(16)	**24** (6)	**9**(3)	**9**(3)	**8**(4)	**8**(2)	**2** (1)	-	**124** ((35)
4th	VII	(4x4) = 16	(4x1) = 4	-	-	-	-	-	-	**20** (5)
	VIII	(4x4) =16@@	(4x1) = 4	-	-	-	-	-	12$$	**20** (5/3)
	[@@ **B. Sc. (Honours)**] **Total credits (**courses**) up to 8th Semester**	**96** (24)	**32** (8)	**9**(3)	**9**(3)	**8**(4)	**8**(2)	**2** (1)	-	**164** (45)
	[$$ **B. Sc. (Honours with Research)**] **Total credits (**courses**) up to 8th Semester**	**84** (21)	**32** (8)	**9**(3)	**9**(3)	**8**(4)	**8**(2)	**2** (1)	**12**$$	**164** (43)

**Credit of courses*: Major (MJC) - 4; Minor (MN) - 4; Multidisciplinary (MD) - 3; Ability Enhancement (AEC) - 2; Skill Enhancement (SEC) - 3; Value-added (VAC)– 4; Internship/Apprenticeship (INT) - 2 and Research Project/Dissertation (RP) - 12.

Additional requirement (to be acquired in Internship during first year and/or second year), if a student wants to get UG Certificate or UG Diploma programme certifications respectively.

@@ In Semester-VIII, B. Sc. (Honours) students will undertake: 03 Major courses for 12 credits (in lieu of a Research Project / Dissertation of 12 credits for Honours with Research students), another 01 Major course of 04 credits and 01 Minor course of 04 credits.

$$ In Semester-VIII, B. Sc. (Honours with Research) students will undertake: a Research Project / Dissertation of 12 credits (in lieu of 03 Major courses of 12 credits for Honours students), another 01 Major course of 04 credits and 01 Minor course of 04 credits.

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3. Semester-wise detailed course curriculum

SEMESTER-VIII

(A) B. Sc. (Honours) in Geology

COURSE CODE	COURSE TITLE	CREDIT			MARKS				NO. OF HOURS PER WEEK		
		Th	Pr.	Total	IA	ESE Th.	ESE Pr.	Total	L	T	P
SGEL-801MJC-21	Research Methodology	4	0	4	10	40	0	50	4	0	0
SGEL-802MJC-22	Medical Geology	4	0	4	10	40	0	50	4	0	0
SGEL-803MJC-23	Climatology	4	0	4	10	40	0	50	4	0	0
SGEL-804MJC-24	Environmental Geology	4	0	4	10	40	0	50	4	0	0
SGEL-805MN-8*	Climatology*	4	0	4	10	40	0	50	4	0	0
Total in Semester- VIII		20	0	20	50	200	0	250	20		

***** To be opted by the students having major course of other discipline

(B) B. Sc. (Honours with Research) in Geology

COURSE CODE	COURSE TITLE	CREDIT			MARKS				NO. OF HOURS PER WEEK		
		Th	Pr.	Total	IA	ESE Th.	ESE Pr.	Total	L	T	P
SGEL-801MJC-21	Research Methodology	4	0	4	10	40	0	50	4	0	0
SGEL-805MN-8*	Climatology*	4	0	4	10	40	0	50	4	0	0
ACS-806RP-1#	Research Project/ Dissertation#	12		12	MARKS						
					Project	Presentation	Viva	Total			
					100	30	20	150			
Total in Semester- VIII		20		20				250			

***** To be opted by the students having major course of other discipline
# 03 (three) copies of project report should be submitted by a student

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4. Distribution of marks and End semester theory question pattern:

A. Distribution of marks:

Type of Course	Theory and/or Practical	Total Marks	Internal Assessment	End Semester Examination	
				Theory	Practical
Major, Minor and Multidisciplinary	Theory	50	10	40	-
	Theory and Practical	50	10	25	15
	Practical	50	10	-	40
Skill Enhancement Course	Practical **(Compulsory geological fieldwork)**	50	10	-	40 (Field Report - 25; Viva Voce - 15)

B. End semester theory question pattern:

a) For 40 marks:

Sl. No.	Questions to be answered	Out of	Marks of each question	Total Marks
1.	5	8	2	5x2 = 10
2.	4	6	5	4x5 = 20
3.	1	2	10	1x10 = 10

b) For 25 marks:

Sl. No.	Questions to be answered	Out of	Marks of each question	Total Marks
1.	5	8	1	5x1 = 5
2.	2	4	5	2x5 = 10
3.	1	2	10	1x10 = 10

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5. Major courses

5.1 RESEARCH METHODOLOGY [SGEL-801MJC-21; 4 Credits: Th.-4; Pr.-0]

(i) Course objectives:

The major objectives of the course are:

(a) to give comprehensive knowledge about the fundamentals of research and its design and proper methodologies,
(b) to give ideas about methods of data collection and apply basic statistical tools for analyzing research data, and
(c) to develop the ability to prepare the research report, presentation and further communication for publication in journals, if possible.

(ii) Course learning outcomes:

The students will be able to:

(a) formulate research problems, its objectives, and appropriate design,
(b) identify the problem related research methodologies,
(c) learn different methods of data collection and apply basic statistical tools for analyzing research data, and
(d) develop the ability to prepare research reports and presentation.

(iii) Course contents:

THEORY
[60 Hours]

Unit 1: Introduction **[10 Hours]**

Meaning, objectives, types, approaches and significance of research; Research methods versus methodology; Research processes; Criteria of good research; Selection of research problem; Techniques involved in defining a research problem; Literature review: purpose, sources, and importance; Formulation of the research objectives; Common problems encountered by the researchers at the beginning.

Unit 2: Research design **[10 Hours]**

Meaning and need of research design; Features of good design; Important concepts relating to research design; Different types of research design; Basic principles of experimental design; Important experimental design; General idea about patent application and patenting.

Unit 3: Plagiarism and research ethics **[10 Hours]**

Definition; Importance of plagiarism detection; Methods of plagiarism detection: manual and automatic; Types of plagiarism; Research ethics; Respect for Intellectual Property; Plagiarism and the Indian context.

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Unit 4: Sampling, data collection and analysis (15 Hours]

Types and sources of data: primary and secondary data, Methods of collecting data, Concept of sampling and sampling methods: sampling errors, characteristics of good sample, different types of sampling; Classification and tabulation of data; Representation of data, graphs and charts: histograms, frequency polygon and frequency curves, different types of curve and their properties; Applications of statistics in research: statistical methods for data analysis, measures of central tendency and dispersion.

Unit 5: Computer application in research: [15 Hours]

Introduction to MS Excel: using formulas and functions, features for statistical data analysis, generating charts/graphs; Introduction to MS Word: features and functions; Writing research report in MS Word; Authentic use of AI while writing research article; Making presentations in MS Power Point.

Suggested readings:

- Cooper, D.R., Schindler, P.S. and Sun, J. (2006) Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
- Creswell, J.W. and Creswell, J.D. (2017) Research design: Qualitative, quantitative, and mixed methods approach. Sage publications.
- Kothari, C.R. and Garg G. (2024) Research methodology: Methods and techniques. New Age International Publishers, New Delhi, 464 pp.
- Krishnaswamy, K.N. (2006) Management Research Methodology: Integration of Principles, Methods and Techniques. Pearson Education India.
- Sekaran, U. and Bougie, R. (2016) Research methods for business: A skill building approach. John Wiley & Sons.
- Singh, B. (2017) Preventing the plagiarism in digital age with special reference to Indian Universities. International Journal of Information Dissemination and Technology, 6(4), 281-287.

5.2 MEDICAL GEOLOGY [SGEL-802MJC-22; 4 Credits: Th.-4; Pr.-0]

(i) <u>Course objectives</u>:

The course aims to focus on:

(a) basic concepts of medical geology i.e., the relationship between geological factors and health problems in human and other animals,

(b) understanding of geogenic and anthropogenic effects on trace elements distribution and their toxic effects on health of human and other animals,

(c) examination of the role of geological factors in the distribution of diseases and environmental health hazards, and

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(d) knowledge of modern analytical techniques and geospatial tools used in medical geology.

(ii) Course learning outcomes:

On completion of the course the student will be able to:

(a) understand the principles and scope of medical geology and its significance in public health,
(b) know the distribution of trace elements and its cyclic movement through the abiotic-biotic environment and their influence on the human health,
(c) evaluate the health impacts of essential and toxic trace elements in geological environments, and
(d) assess geological factors controlling contamination of air, water, and soil and their effects on human health.

(iii) Course contents:

THEORY
[60 Hours]

Unit-1: Introduction [10 Hours]

Definition; History and development of medical geology; Interaction between geological environments and human health: a few examples of studies of medical geology; Theoretical principles of medical geology; Goal, task and significance of medical geology.

Unit 2 Geological environment, bioavailability of trace elements and risk assessment [20 Hours]

Basic features of geological environments; biological classification of elements; geochemobiological pathways; Characteristics of geological factors and their influence on human health; Interaction between abundances of elements and isotopes and their effects on health of humans and plants, biogeochemical interactions and nutrient anomalies, anthropogenic degradation of geological environments; Bioaccumulation; Bioavailability; Risk assessment; Aspects of epidemiology in medical geology; Causation and correlation; Homoeostasis in medical geology.

Unit 3: Health issues arising from selected elements, geological materials and processes [15 Hours]

Excessiveness of arsenic with a few case studies in India; Iodine Deficiency Disorder (IDD); Deficiency and excessiveness of selenium; Toxicity effects of excess fluoride; Health effects of cadmium and radon gas; Geophagy: geophagy among human, geophagy among animals, ingestion of geomaterials for human health-the medical concerns; Podoconiosis; Natural dust and pneumoconiosis; Health hazards associated with volcanic eruption; Health benefits and medicinal uses of geological materials

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Unit 4: Water and health **[10 Hours]**

Medical impacts of water quality; Geogenic and anthropogenic contamination of groundwater; Water hardness in relation to human cardiovascular diseases and urinary stones; Radionuclides and deuterium/tritium ratio as causative factors for cancer; Geological controls on waterborne diseases; Assessment of water quality for public health.

Unit 5: Techniques and tools used in medical geology **[5 Hours]**

Geochemical sampling and analysis; Spectroscopy; X-ray analytical techniques; GIS applications in medical geology; Spatial mapping of disease distribution and geogenic hazards; Remediation and mitigation strategies; Environmental management and sustainable practices.

Suggested readings:

- Bish, D.L., and Post, J.E., eds., (1989) Modern Powder Diffraction, Min. Soc. America Reviews in Mineralogy Vol. 20, 369 p.
- Dissanayake, C. B. and Chandrajith, R. (2009) Introduction to Medical Geology, Springer-Verlag Berlin Heidelberg.
- Eisenbud, M. and T. Gesell. (1997) Environmental radioactivity from natural, industrial, and military sources, Academic Press.
- Miomir Komatina (2004) Medical Geology, Volume 2, Effects of Geological Environments on Human Health, Elsevier Science.
- Proceedings 'Workshop on Medical Geology' IGCP 454, 3-4th February, 2004, Special Publication No: 83 Geological Survey of India.
- Selinus, O., Brian., A et. al. (2005) Introduction to Medical Geology, Springer, 808 pp.
- Suryanarayana C. and Grant, M.N. (1998) X-Ray Diffraction: A Practical Approach. Plenum Press, New York.

5.3 CLIMATOLOGY [SGEL-803MJC-23; 4 Credits: Th.-4; Pr.-0]

(i) Course objective:

The major objectives of the course are:

(a) to develop introductory knowledge of climatological processes and their roles in Earth's climate system.

(b) to empathize a wide-ranging understanding of the physical, chemical, biological, and geological aspects of the atmosphere, and

(c) to offer comprehensive ideas on atmospheric currents, heat budget, monsoon, orbital cyclicity, climate variability and global climate change.

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(ii) Course learning Outcome:

The students will learn:

(a) the essential principles of climatology, including the structure and composition of the atmosphere,

(b) the important physical, chemical, biological, and geological processes in the atmospheric systems, and

(c) about the role of atmospheric circulation in global climate regulation and weather patterns, heat budget, monsoon and orbital cyclicity.

(iii) Course contents:

THEORY

[60 Hours]

Unit 1: Introduction [10 Hours]

Definition, aims, objects and sub-divisions of climatology; Meteorology and climatology; Concept of Weather and Climate; Weather elements; Climatic controls; Climate and civilization; Effect of individual climatic elements on human life.

Unit 2: Atmosphere [15 Hours]

Layered structure of atmosphere; Modern views regarding the structure of atmosphere; Variation in air pressure and weather; Basic atmospheric pressure patterns; General characteristics of cyclones and anticyclones; Vertical and horizontal variation in air-pressure; Winds: factors affecting wind motion, wind observation and measurement; Earth's normal surface wind systems; Latitudinal shifting of wind belts; Winds in tropical and subtropical regions; Westerlies and polar winds; Jet stream and surface weather; Atmosphere and ocean interaction and its effects on climate; Humidity in atmosphere: relative humidity, variation and causes of humidity change - diurnal and annual.

Unit 3: Insolation, heat budget and temperature of atmosphere [10 Hours]

Insolation and its distribution; Atmospheric depletion of solar radiation; Heat budget; Latitudinal heat balance; Processes of transfer of heat energy; Heating and cooling of atmosphere; Control of temperatures; Horizontal and vertical distribution of temperature; Seasonal distribution of temperature; Temperature inversion; Isanomalous temperature.

Unit 4: Fog and clouds [05 Hours]

Necessary conditions for condensation; Forms of condensation; Different classifications of fog and clouds; Fog dissipation processes, Distribution of fog; Clouds as an aid to weather forecasting.

Unit 5: The monsoon [10 Hours]

Monsoon-its different meanings; Economic importance of the monsoon; Different concepts of the origin of monsoon; The Indian monsoon; Classical and recent theories of Indian monsoon;

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Seasonal changes in India; Pseudo-monsoon areas of the world; Climatic significance of monsoon; Different weather forecasting methods.

Unit 6: Climate changes, orbital cyclicity and other controls on climate [10 Hours]

Different climate classification schemes; Climatic types and their distribution; Reconstruction of past climates; Different theories of climate change; Milankovitch cycles and variability in the climate; Climatic changes through geologic time: glacial-interglacial periods, the Last Glacial Maximum (LGM), Pleistocene glacial-interglacial cycles.

Suggested readings:

- Aguado, E., and Burt, J. (2009) Understanding weather.
- Lal, D. S. (2021) Climatology, Sharada Pustak Bhaban, Prayagraj.
- Lutgens, F., Tarbuck, E., and Tasa, D. (2009) The Atmosphere: An Introduction to Meteorology. Pearson Publisher.
- Rohli, R.V., and Vega, A. J. (2007) Climatology. Jones and Barlatt.
- Rudiman, W.F. (2001) Earth's climate: past and future. 2nd Edition, Freeman Publisher.

5.4 ENVIRONMENTAL GEOLOGY [SGEL-804MJC-24; 4 Credits: Th.-4; Pr.-0]

(i) Course objectives:

The major objectives of the course are:

(a) to introduce the philosophy and fundamental concepts behind environmental geology through understanding of the interactions between geologic processes, ecological processes, and society,
(b) to understand the problems related to Earth processes and natural hazards,
(c) to determine the standard of living and the quality of our environment through the increasing uses of natural resources such as water, soil, air, minerals and energy, and
(d) to give comprehensive idea on environmental management and environmental legislation.

(ii) Course learning outcomes:

The students will learn:

(a) the basic concepts of environmental geology and the interactions between geologic processes, ecological processes, and society,
(b) the problems related to Earth processes and natural hazards,
(c) the quality of our environment through the increasing uses of natural resources such as water, soil, air, minerals and energy, and
(d) the environmental management, environmental legislation and sustainable future.

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(iii) Course contents:

THEORY

[60 Hours]

Unit 1: Introduction **[10 Hours]**

Objectives of environmental geology; Fundamental concepts of environmental geology: human population growth, sustainability, Earth as a system, hazardous Earth processes, scientific knowledge and values; Plate tectonics and environmental geology; Geology and biodiversity; Ecological restoration.

Unit 2: Earth processes and natural hazards **[20 Hours]**

Hazards, disasters and natural processes; Human responses to hazards; Hazards related to population increase and land-use changes; Earthquake and related phenomena: earthquake caused by human activities, effects of earthquake, earthquake risk and earthquake prediction, response to earthquake hazards, mitigation of earthquake; Volcanic hazards: forecasting volcanic activity, adjustment to volcanic hazards; Rivers and flooding: effects of land-use changes and urbanisation; Landslides, subsidence and related problems; Coastal hazards; Hazards caused by the impact of extraterrestrial objects.

Unit 3: Resources and pollution **[15 Hours]**

Water resources and water pollution: future water management, water and ecosystem, emerging global water shortage; Mineral resources: environmental impact of mineral development, recycling of mineral resources, minerals and sustainability; Geological impacts on environment related to energy resources, soils, waste management and air pollution.

Unit 4: Global climate change **[10 Hours]**

Tools for studying global climate change; Global warming: causes and effects, CO_2 increase in the present atmosphere, levels of present and past atmospheric carbon-dioxides, ozone depletion; Meaning and importance of carbon sequestration; Carbon sequestration processes: biologic and geologic.

Unit 5: Geology, society and the future **[05 Hours]**

Geology and environmental health, Environmental impact analysis; Land-use and planning, Environmental legislations; Role of Geology for the sustainable future.

Suggested readings:

- Bell, F. G. (1999) Geological Hazards, Routledge, London
- Bryant, E. (1985) Natural Hazards, Cambridge University Press
- Keller, E. A. (2008) Introduction to Environmental Geology, Pearson Prentice Hall, Upper Saddle River, NJ 07458.
- Patwardhan, A. M. (1999) The Dynamic Earth System. Prentice Hall
- Smith, K. (1992) Environmental Hazards. Routledge, London

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- Subramaniam, V. (2001) Textbook in Environmental Science, Narosa International.

6. Minor course

6.1 CLIMATOLOGY [SGEL-805MN-8; 4 Credits: Th.-4; Pr.-0]

(i) Course objective:

The major objectives of the course are:

(d) to develop introductory knowledge of climatological processes and their roles in Earth's climate system.

(e) to empathize a wide-ranging understanding of the physical, chemical, biological, and geological aspects of the atmosphere, and

(f) to offer comprehensive ideas on atmospheric currents, heat budget, monsoon, orbital cyclicity, climate variability and global climate change.

(ii) Course learning Outcome:

The students will learn:

(d) the essential principles of climatology, including the structure and composition of the atmosphere,

(e) the important physical, chemical, biological, and geological processes in the atmospheric systems, and

(f) about the role of atmospheric circulation in global climate regulation and weather patterns, heat budget, monsoon and orbital cyclicity.

(iii) Course contents:

THEORY

[60 Hours]

Unit 1: Introduction **[10 Hours]**

Definition, aims, objects and sub-divisions of climatology; Meteorology and climatology; Concept of Weather and Climate; Weather elements; Climatic controls; Climate and civilization; Effect of individual climatic elements on human life.

Unit 2: Atmosphere **[15 Hours]**

Layered structure of atmosphere; Modern views regarding the structure of atmosphere; Variation in air pressure and weather; Basic atmospheric pressure patterns; General characteristics of cyclones and anticyclones; Vertical and horizontal variation in air-pressure; Winds: factors affecting wind motion, wind observation and measurement; Earth's normal surface wind systems; Latitudinal shifting of wind belts; Winds in tropical and subtropical

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regions; Westerlies and polar winds; Jet stream and surface weather; Atmosphere and ocean interaction and its effects on climate; Humidity in atmosphere: relative humidity, variation and causes of humidity change - diurnal and annual.

Unit 3: Insolation, heat budget and temperature of atmosphere [10 Hours]

Insolation and its distribution; Atmospheric depletion of solar radiation; Heat budget; Latitudinal heat balance; Processes of transfer of heat energy; Heating and cooling of atmosphere; Control of temperatures; Horizontal and vertical distribution of temperature; Seasonal distribution of temperature; Temperature inversion; Isanomalous temperature.

Unit 4: Fog and clouds [05 Hours]

Necessary conditions for condensation; Forms of condensation; Different classifications of fog and clouds; Fog dissipation processes, Distribution of fog; Clouds as an aid to weather forecasting.

Unit 5: The monsoon [10 Hours]

Monsoon-its different meanings; Economic importance of the monsoon; Different concepts of the origin of monsoon; The Indian monsoon; Classical and recent theories of Indian monsoon; Seasonal changes in India; Pseudo-monsoon areas of the world; Climatic significance of monsoon; Different weather forecasting methods.

Unit 6: Climate changes, orbital cyclicity and other controls on climate [10 Hours]

Different climate classification schemes; Climatic types and their distribution; Reconstruction of past climates; Different theories of climate change; Milankovitch cycles and variability in the climate; Climatic changes through geologic time: glacial-interglacial periods, the Last Glacial Maximum (LGM), Pleistocene glacial-interglacial cycles.

Suggested readings:

- Aguado, E., and Burt, J. (2009) Understanding weather.
- Lal, D. S. (2021) Climatology, Sharada Pustak Bhaban, Prayagraj.
- Lutgens, F., Tarbuck, E., and Tasa, D. (2009) The Atmosphere: An Introduction to Meteorology. Pearson Publisher.
- Rohli, R.V., and Vega, A. J. (2007) Climatology. Jones and Barlatt.
- Rudiman, W.F. (2001) Earth's climate: past and future. 2nd Edition, Freeman Publisher.

7. Research Project/Dissertation [AEC-806RP-1; Toal Credit: 12]

In Semester-VIII, B. Sc. (Honours with Research) students will undertake a Research Project / Dissertation of 12 credits (in lieu of 03 Major courses of 12 credits). Following the guidelines of the university, the total marks allotted for Research Project / Dissertation is 150. The break-up of the marks is: (a) Project Report -100, (b) Presentation – 30, and (c) Viva Voce – 20. Three (03) copies of project report should be submitted by the student.

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8. Programme Outcomes

A. **Graduate Attributes**: The quality and feature or characteristics of an individual, including the knowledge, skills, attitudes, and values that are expected to be acquired by a graduate through studies at the higher education institution.

Some of the characteristic attributes that a graduate should demonstrate:
i) Disciplinary knowledge
ii) Communication Skills
iii) Critical thinking
iv) Problem solving ability
v) Analytical reasoning
vi) Research-related skills vii) Cooperation/Teamwork viii) Scientific reasoning
ix) Reflective thinking
x) Information/digital literacy xi) Self-directed learning
xii) Multicultural competence
xiii) Moral and ethical awareness/reasoning
xiv) Leadership readiness/qualities
xv) Lifelong learning, and
xvi) Development of pleasing personality and readiness to share responsibilities.

B. **Qualification descriptors:** The generic outcomes and attributes expected for the award of a particular type of qualification (for e.g. a bachelor's degree or a bachelor's degree with honours).

Qualification descriptors for a bachelor's degree with honours

(a) Demonstrate (i) a systematic, extensive and coherent knowledge and understanding of an academic field of study as a whole and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of study; (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of study, including research and development, teaching and government and public service; (iii) skills in areas related to one's specialization and current developments in the academic field of study, including a critical understanding of the latest developments in the area of specialization, and an ability to use established techniques of analysis and enquiry within the area of specialization.

(b) Demonstrate comprehensive knowledge about materials, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the chosen disciplinary areas (s) and field of study, and techniques and skills

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required for identifying problems and issues relating to the disciplinary area and field of study.

(c) Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, analysis and interpretation of data using methodologies as appropriate to the subject(s) for formulating evidence-based solutions and arguments.

(d) Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.

(e) Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s) of study.

(f) Address one's own learning needs relating to current and emerging areas of study, making use of research, development, and professional materials as appropriate, including those related to new frontiers of knowledge.

(g) Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyze problems and issues and seek solutions to real-life problems.

(h) Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities.

9. Programme Specific Outcomes

The student graduating with the degree B. Sc. (Honours/Honours with Research) in Geology should be able to

a) Acquire

i. a fundamental/systematic or coherent understanding of the academic field of Geology, its different learning areas and applications in basic Geology like Mineralogy, Petrology, Stratigraphy, Structural Geology, Palaeontology, Economic geology, Hydrogeology, etc. and its linkages with related interdisciplinary areas/subjects like Geography, Environmental sciences, Physics, Chemistry, Mathematics, Life sciences, Atmospheric sciences, Remote Sensing, Computer science, Information Technology;

ii. procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Geology, including professionals engaged in research and development, teaching and government/public service and industrial geology.

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iii. skills in areas related to one's specialization area within the disciplinary/subject area of Geology and current and emerging developments in the field of Geosciences.

(b) Demonstrate the ability to use skills in Geology and its related areas of technology for formulating and tackling geosciences-related problems and identifying and applying appropriate geological principles and methodologies to solve a wide range of problems associated with geosciences.

(a) Recognize the importance of RS and GIS, mathematical modelling, simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

(b) Plan and execute Geology-related experiments or investigations, analyse and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories in Geology.

Demonstrate relevant generic skills and global competencies, such as:

(a) problem-solving skills that are required to solve different types of geoscience-related problems with well-defined solutions and tackle open-ended problems that belong to the disciplinary area boundaries;
(b) investigative skills, including skills of independent investigation of geoscience-related issues and problems.
(c) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
(d) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Geology and ability to translate them with popular language when needed;
(e) ICT skills; and
(f) personal skills such as the ability to work both independently and in teams

Demonstrate professional behaviour such as being: (a) objective, unbiased, and truthful in all aspects of work and avoiding unethical, irrational behaviour such as fabricating, falsifying or misrepresenting data or committing plagiarism; b) the ability to identify the potential ethical issues in work-related situations; c) appreciation of intellectual property, environmental and sustainability issues; and d) promoting safe learning and working environment.

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