Course title: Advanced Geosciences			
Course code: NRE 170	**No. of credits:** 3	**L-T-P:** 38-07-0	**Learning hours:** 45
Pre-requisite course code and title (if any): Environmental Geosciences			
Department: Natural and Applied Sciences			
Course coordinator: Dr CK Singh/ Dr. Chandrashekhar Azad Vishwakarma		**Course instructor:** Dr CK Singh/ Dr. Chandrashekhar Azad Vishwakarma	
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Course type: Elective		**Course offered in:** Semester 2	

Course Description

Contemporary geology driven environmental issues such as geological episodic events, geogenic pollution, depletion of natural resources and global climate change are intrinsically linked with the various components of the Earth's systems and its processes. Thus, for effective management of the environment and its resources, knowledge on the Earth's physical functioning and its inter-linkages with the various developmental aspects are essential.

This course will provide the students with a advance understanding of the key processes of the Earth's system and its linkages with natural disasters and anthropogenic interferences. Different aspect of earth's processes and natural resources will be discussed in the context of environmental challenges.

The course will provide the necessary knowledge and skillsets to the students for analyzing the trends in Earth's environment and the causative agents.

Course objectives

- This course will provide a detailed understanding of the key processes of the Earth's system related to the developments and current environmental challenges.
- It will enable them to understand the effects of anthropogenic interferences on Earth's functioning, and its impact on geological/geomorphological changes.

Course content

Module	Topic	L	T	P
1.	**Introduction** Earth structure; Geologic Time Scale; Dynamics of Geological Processes;	4		
2.	**Earth processes (interior and surface)** Tectonic Geomorphology - geomorphic indicators of tectonic activity and paleoseismicity Mass movement – classification; Hillslope evolution and stabilization Floodplains – channel and flood plain evolution; Streams - processes of transport, depositional features, drainage patterns Coastal zones and processes – nature of coastline (emergent and submergent coastlines), coastal erosion and stabilization Deserts and desertification, wind action (erosional and transport processes), semiarid regions - features and processes Glaciers – classification and dynamics, erosional features and deposits Weathering – mechanical, chemical and biological weathering, weathering of silicate minerals	14	3	
3.	**Natural Resources** Groundwater – hydrogeology, storage and mobility, withdrawal and its consequences, aquifer characteristics, aquifer types, porosity, permeability Surface water – reservoirs, processes, management Soil – high temperature geochemistry, genesis, classification, degradation, soil survey and land use planning, Issues related to over-exploitation and pollution, geogenic	7		

	contaminants.			
4.	**Mineral resources** Metal and non-metal mineral deposits, Hydrocarbons and Radioactive mineral deposits for energy; Global mineral supplies; Ore deposits in India, National mineral policy.	6		
5.	**Field and Laboratory Methods in Environmental Geoscience** Interpretation of geologic maps; Geophysical logging and interpretation; Data mining and data analysis/interpretation in geosciences; Map reading, Geological cross-section preparation, Use of Brunton compass to read the attitude and dip of the geological formation. Hand specimens of rocks and minerals.	8	4	
	Total	**38**	**7**	**0**

Evaluation criteria

Test 1: Written Test [at the end of module 1 and 2. The enhanced understanding of earth's interior and how does it control of impact the surface processes will be evaluated. How these internal processes shape the earth's exterior would be expected to be learnt] **20%**

Test 2: Written Test [at the end of module 3,4 and part of module 5. The students learn about the components which how earth system components drive or control the earth processes specifically in terms of resources such as soil, water, mineral. The subsurface information collection through different techniques would also provide insights on data collection and its interpretation] **20%**

Test 3: Written Test [at the end of entire syllabus, module 1-5. Integrating all the knowledge gathered about surface and sub-surface processes to understand interdependence of geological processes in shaping the earth**]** **40%**

Assignment: 20% [Case study based on holistic understanding of earth surface and subsurface processes. The students would be required to submit case studies by integrating the knowledge gained through the course and identify major geological processes that shape the earth system. **20%**

Learning outcomes

- The student will have enhanced understanding of earth's interior and surface processes (Test 1)
- Understand the earth's geological processes, mineral formations and infer the subsurface information using field techniques (Test 2)
- Overall in-depth understanding techniques to gather geological information and to apply knowledge in understanding processes that shape the earth. (Test 3 and assignment)

Pedagogical approach

Pedagogical approach consists of classroom teaching enriched with theories, frameworks, and methods combined with hands on exercises on application of tools and techniques, discussion of case studies, presentation of case studies by students.

Materials

Required text

1. H. Chamley (2003). Geosciences, Environment and Man. Elsevier Science.
2. C. Montgomery (2020) Environmental Geology. McGraw-Hill Education
3. E.A. Keller (2012) Introduction to Environmental Geology. Pearson Education.
4. K.S. Valdiya (2013). Environmental Geology: Ecology, Resource and Hazard Management. Tata McGraw-Hill Education
5. B.R. Frost and C.D. Frost (2019). Essentials of Igneous and Metamorphic Petrology, Cambridge University Press.
6. S. Boggs Jr. (2012) Principles of Sedimentology and Stratigraphy. Pearson Education.
7. J.I. Drever (1997) The Geochemistry of Natural Waters: Surface and Groundwater Environments. Prentice-Hall Publishers

8. K.M. Hiscock and V.F. Bense (2014) Hydrogeology: Principles and Practice. Wiley-Blackwell.
9. N. Lu and J.W. Godt (2013) Hillslope Hydrology and Stability. Cambridge University Press.
10. R.J. Huggett (2017). Fundamentals of Geomorphology. Taylor & Francis.
11. D.L. Turcotte and G. Schubert (2014). Geodynamics. Cambridge University Press.
12. R.S. Anderson and S.P. Anderson (2010) Geomorphology: The Mechanics and Chemistry of Landscapes. Cambridge University Press.
13. Edwards R. and Atkinson K. (1986); Ore Deposit Geology, and its Influence on Mineral Exploration. Chapman and Hall.
14. M.L. Jenson and A.M. Bateman (2013), Economic Mineral deposits. John Wiley
15. S. Marshak and G. Mitra (2017). Basic Methods of Structural Geology. Pearson Education.
16. A.L. Coe (Ed.) (2010) Geological Field Techniques. Wiley-Blackwell.

Suggested readings

Case studies

- Schiappa, T.A. and Smith, L., 2019. Field experiences in geosciences: A case study from a multidisciplinary geology and geography course. Journal of Geoscience Education, 67(2), pp.100-113.
- Dolphin, G., Dutchak, A., Karchewski, B. and Cooper, J., 2019. Virtual field experiences in introductory geology: Addressing a capacity problem but finding a pedagogical one. Journal of Geoscience Education, 67(2), pp.114-130.
- Gilley, B., Atchison, C., Feig, A. and Stokes, A., 2015. Impact of inclusive field trips. Nature Geoscience, 8(8), pp.579-580.
- Hallar, A.G., McCubbin, I.B., Hallar, B., Levine, R., Stockwell, W.R., Lopez, J.P. and Wright, J.M., 2010. Science in the mountains: A unique research experience to enhance diversity in the geosciences. Journal of Geoscience Education, 58(2), pp.95-100.

Journals

- Nature Geoscience
- Journal of Structural Geology
- Geoscience Frontiers
- Geosciences Journal, Springer

Advanced Reading Material

Additional information (if any)

Student responsibilities

The students are expected to submit assignments in time and come prepared with readings when provided

Course reviewers:

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Dr. Umesh Kumar Singh, Professor, Department of Environmental Science, School of Earth, Biological and Environmental Sciences, Central University of South Bihar, Bihar

Dr. Saumitra Mukherjee, Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi