PUNJAB PUBLIC SERVICE COMMISSION

COMBINED COMPETITIVE EXAMINATION (CCE) SYLLABUS

GEOLOGY

Total Marks: 100

	Topics
1	**General Geology:** The Earth as a member of the Solar System. Origin, age, composition, and internal structure of the Earth. Major rock-forming minerals. Basic description and classification of igneous, sedimentary, and metamorphic rocks. Geomorphic processes, including internal and external processes. Valley formation and drainage patterns. Glacial processes and landforms.
2	**Structural Geology:** Physical properties of rocks and their mechanical behavior under different tectonic conditions. Stress and strain and their relationship to rock deformation. Deformation through folding and fracturing. Major geological structures, including: Folds, Faults, Joints, Cleavage, Lineations and other linear structures. Structural interpretation in relation to tectonic environments.
3	**Paleontology:** Fundamental principles and techniques of paleontology. Origin and evolution of life through geological time. Fossils and the process of fossilization. Modes of fossil preservation. Classification and identification of fossils. Biostratigraphic applications of fossils. Geological significance and environmental interpretation of fossils.
4	**Stratigraphy and Sedimentology:** Fundamental principles of stratigraphy. Stratigraphic record and its interpretation. Geological Time Scale. Concepts of Sequence stratigraphy and its applications. Origin and sources of sediments. Weathering, erosion, transportation, and deposition of sediments. Sedimentary processes and sedimentary environments. Sedimentary structures and textures. Depositional environments and their interpretation. Importance of Sedimentology in natural resource exploration.
5	**Mineralogy, Petrology, and Geochemistry:** Crystal chemistry and crystal structures. Crystal growth and mineral genesis. Mineral identification and classification. Stability and alteration of minerals. Mineralogical, chemical, textural, and structural characteristics of rocks. Origin, classification, and evolution of Igneous, Sedimentary and Metamorphic rocks. Chemical processes involved in the development and evolution of the Earth. Distribution and abundance of elements in the Earth's crust, atmosphere, and oceans. Stable and volatile elements and their geochemical behavior. Geochemical processes affecting minerals and rocks. Formation and stability of soil minerals.
6	**Earth Resources and Economic Geology:** Classification, occurrence, exploration, and utilization of Earth's natural resources. Fossil fuels, including: Coal, Petroleum, Natural gas, Nuclear mineral resources. Uranium and strategic metals. Renewable energy resources. Hydropower resources. Geothermal energy. Water resources: Hydrological cycle Surface water and Groundwater. Construction materials, including: Concrete aggregates, Sand and gravel, Cement-making materials and Building stones. Fundamentals of metallogeny. Mineral deposits and their geological controls. Sustainable management of geological and natural resources.

Topics

7 **Fundamentals and scope of engineering geology:** Engineering properties of soils and rocks. Principles of excavation in rock and soil. Landslides and their classification in rock and soil. Causes and mechanisms of slope failure. Basic principles of slope stability analysis. Site investigation and geological characterization. Geological considerations in the selection and evaluation of dam sites. Occurrence and movement of groundwater. Aquifers and aquifer properties. Groundwater recharge and discharge.

8 **Remote Sensing (RS) and Geographic Information Systems (GIS):** Principles and applications of remote sensing and GIS. Earth satellite systems and satellite-based observations. Types of remotely sensed data and imagery. Basic principles of image interpretation. GIS data structures and data types. Spatial and attribute data. Methods of spatial data analysis. Data management and visualization. Cartographic modeling. Applications of RS and GIS in geological and environmental studies**.**

9 **Environmental Geology, Climate, and Climate Change:** Introduction to environmental geology. Scientific basis of the climate system and climate change. Geological and environmental evidence of past climate change. Impacts of climate change on different regions of the world. Climate-related geological and environmental hazards. Adaptation and mitigation strategies. Relationship between Earth's geological processes and environmental change.

10 **Regional Geology and Geology of Pakistan:** Geological framework and tectonic evolution of Pakistan**.** Major geological provinces and tectonic zones of Pakistan. Plate tectonics and its application to the geological evolution of Pakistan. Stratigraphy of the Upper, Middle and Lower Indus Basin. Major Basin of Pakistan. Mineral and energy resources of Pakistan. Metallogeny and mineral deposits of Pakistan. Geological significance of major dams and engineering
projects in Pakistan. Major groundwater and surface-water resources of Pakistan.

11 **Information Technology, Artificial Intelligence, and Digital Applications in Geology:** Applications of Information Technology in geological data collection, processing, analysis, and visualization. Introduction to digital geological mapping, databases, GIS, and remote sensing. Fundamentals of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL). Applications of AI and ML in geological mapping, mineral exploration, geohydrology, engineering geology, and environmental studies. AI-based interpretation of geological, geochemical, geophysical, and remote-sensing data. Applications of drones, LiDAR, 3D geological modelling, and digital mapping.

Suggested readings:

1. Barnes, J. W., & Lisle, R. J. (2004). *Basic Geological Mapping*. John Wiley & Sons.
2. Bell, F. G. (2004). *Engineering Geology and Construction*. Spon Press, New York.
3. Bender, F. K., & Raza, H. A. (1995). *Geology of Pakistan*. Gebrüder Borntraeger.
4. Best, M. G. (2003). *Igneous and Metamorphic Petrology*. Blackwell Science.

5. Davis, G. H., & Reynolds, S. J. (1996). *Structural Geology of Rocks and Regions*. John Wiley & Sons.
6. Demers, M. N. (2005). *Fundamentals of Geographic Information Systems*. John Wiley & Sons.
7. Emery, D., & Myers, K. J. (1996). *Sequence Stratigraphy*. Blackwell.
8. Hudak, P. F. (2005). *Principles of Hydrogeology* (3rd ed.). CRC Press.
9. Kazmi, A. H., & Abbas, S. G. (2001). *Metallogeny and Mineral Deposits of Pakistan*. Orient Petroleum Inc.
10. Kazmi, A. H., & Jan, M. Q. (1997). *Geology and Tectonics of Pakistan*. Graphic Publishers.
11. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). *Remote Sensing and Image Interpretation*. Wiley
12. Montgomery, C. W. (2005). *Environmental Geology*. McGraw-Hill.
13. North, F. K. (1985). *Petroleum Geology*. Allen & Unwin.
14. Plummer, C. C., Carlson, D. H., & McGeary, D. *Physical Geology*. McGraw-Hill.
15. Raup, D. M., & Stanley, S. M. (1985). *Principles of Paleontology*. W. H. Freeman & Co.
16. Boggs, S. (1987). *Principles of Sedimentology and Stratigraphy*.
17. Shah, S. I. (1977). *Stratigraphy of Pakistan*. Geological Survey of Pakistan.
18. Solomon, S., Qin, D., & Manning, M. (2007). *Climate Change 2007: The Physical Science Basis*. Intergovernmental Panel on Climate Change (IPCC).
19. Thomas, M. L., & Ralph, W. K. (2003). *Remote Sensing and Image Interpretation*. John Wiley & Sons.
20. William, H. B. (1990). *Principles of Mineralogy*. Oxford University Press.

Note: **The above list is only suggestive and not exhaustive. Candidates may consult other standard books and relevant material covering the prescribed syllabus.**

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