DEPARTMENT OF GEOLOGY

VINOBA BHAVE UNIVERSITY, HAZARIBAG

NEP 2020 SYLLABUS

FOUR YEAR COURSE STRUCTURE OF UNDERGRADUATE PROGRAMME IN GEOLOGY UNDER NEP 2020

First year – Undergraduate Certificate

Students opting Geology as major subject have to select a subject associated with Geology (such as Botany, Chemistry, Mathematics, Physics, Zoology, Geography) as Minor.

Semester Internal Examination (SIE 20 + 5 = 25)

The semester internal examination shall have two components

a) One Semester Internal Assessment written test of 20 marks

b) Class Attendance Score (CAS) including the behaviour of the students towards teacher and other students of the college of 5 marks.

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

MAJOR (MJ)

Semester - I

Physical Geology – 4 Credits – 100 Marks – MJ-1/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

The study of this paper strengthens students' knowledge with respect to understanding the essentials of the structural dynamics of the earth.

Course content:

Physical Geology

Geology- its branches with other branches of science. Study of atmosphere and hydrosphere, Radioactivity and age of the earth, an elementary idea of seismic waves and interior of the earth. Origin of the earth. Earth in the solar system-Size, Shape, Mass, Density, Rotational and Revolutional parameter.

[**Lecture – 30**]

Concept of isostasy, Origin and significance of mid-oceanic ridges and trenches. Sea floor spreading, continental drift. Brief idea about plate tectonics. Mitigation of environmental hazards- Earthquakes, floods, landslides.

[**Lecture – 20**]

A detailed account of the geological work of natural agencies- groundwater, rivers, glaciers, ocean and wind. Drainage pattern and its significance.

[**Lecture – 10**]

Books Recommended:

1. Arthur Holmes, (1992) Principles of Physical Geology. Chapman and Hall, London.
2. Miller, (1949) An Introduction to Physical Geology. East West Press Ltd.
3. Spencer, E.V., (1962) Basic concepts of Physical Geology. Oxford & IBH.
4. Mahapatra, G.B., (1994) A text book of Physical Geology. CBS Publishers.
5. Press and Siever (1998) Understanding Earth, WH Freeman & Co.
6. Emiliani, C. (1992) Planet earth: cosmology, geology, and the evolution of life andenvironment. Cambridge University Press

Semester - II

Crystallography, Mineralogy and Optical Mineralogy – 4 Credits – 100 Marks – MJ-2/VUG-GEL [(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Studying the basics of mineralogy and crystallography helps in understanding and building the overall knowledge in Geology. The course deals with the study of minerals, their chemistry and identification in hand specimen. Further, it also deals with the study of crystals with respect to their morphology, symmetry and the normal crystal classes. The students will be able to identify common rock-forming minerals in hand specimens as well as in thin sections.

Course content:

Mineralogy

Mineral- definition and classification; Isomorphism, Polymorphism, Solid solution and exsolution; Mineralogy of common rock-forming minerals; Physical properties, chemical composition and uses of the following minerals - quartz, orthoclase, microcline, kyanite, sillimanite, calcite, gypsum, apatite, talc, fluorite, corundum, topaz, garnet, biotite, muscovite, beryl.

[**Lecture – 20**]

Optical Mineralogy

Nature of light. Polarization of light. Uniaxial and biaxial minerals. Phenomenon of double refraction. Nicol prism – its construction and function. Construction and function of petrological microscope. Optical properties of minerals - relief, colour and pleochroism, interference colours, birefringence, extinction and extinction angle, optic sign of uniaxial and biaxial minerals.

[**Lecture – 20**]

Crystallography

Elementary ideas about crystal structure. Crystalline and amorphous substances. Crystal: faces, edges, solid angles and interfacial angles. Crystallographic axes and axial angles. Crystallographic forms. Symmetry elements- plane, axis, centre and rotary inversion axis of symmetry. Parameter, indices and symbol. Laws of crystallography. Symmetry elements and common forms of normal classes of six crystal system.

[**Lecture – 20**]

MJ-3/VUG-GEL (Practical) – 100 ESE

1. Clinographic projection of important crystal forms.
2. Stereographic projection of Important crystal forms/models
3. Study of physical properties of minerals mentioned in theory course.
4. Use of polarizing microscope; Study of optical properties of important rock forming minerals.
5. Determination of length fast and length slow characters of minerals; Scheme of pleochroism, extinction.
6. Geological field work for 7 days related to sedimentary mapping.

Books Recommended:

1. Ram S. Sharma and Anurag Sharma (2013) Crystallography and Mineralogy - Concepts and Methods. Text Book Series, Geological Society of India, Bangalore
2. Dana, E.S. and Ford, W.E., (2002) A textbook of Mineralogy (Reprints).
3. Flint, Y., (1975) Essential of crystallography, Mir Publishers.
4. Phillips, F.C., (1963) An introduction to crystallography. Wiley, New York.
5. Berry, L.G., Mason, B. and Dietrich, R.V., (1982) Mineralogy. CBS Publ.
6. Read, H.H., (1968) Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby andCo.
7. Berry and Mason, (1961) Mineralogy. W.H. Freeman & Co.
8. Kerr, B.F., (1995) Optical Mineralogy 5th Ed. McGraw Hill, New York.
9. Deer, Howie and Zussman (1996) Introduction to Rock forming Minerals, Pearson
10. Wahlstrom E.E. (1971) Optical crystallography, John Wiley and sons.
11. R.N. Hota (2012) Practical approach to Mineralogy and Crystallography, CBS Publications & Distributions.
12. Perkin D. (2010) Mineralogy, Pearson.

Second year – Undergraduate Diploma

Semester - III

Structural Geology – 4 Credits – 100 Marks – MJ-4/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

The course deals with geological structures resulting from the action of these forces on rocks. The student will gain knowledge of the geometry of the rock structures, understand the mechanism of the evolution of rock structures and its application in the field. The course is designed for the students to understand the geometry and mechanics of the various geological structures that result through the deformative processes operative within the earth. The students learn the skills of identifying different structure and measurements using Brunton compass. This is fundamental to geological mapping.

Course content:

Structural Geology

Topographic and structural maps. Stress and strain in rocks, Strain ellipses of different types and their geological significance. Planar and linear structures; Concept of dip and strike; Outcrop patterns of different structures. Folds, fold morphology; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding.

[**Lecture – 30**]

Foliation and lineation, description and origin of foliations: axial plane cleavage and its tectonic significance. Description and origin of lineation and relationship with the major structures. Faults geometric and genetic classification of faults. Effects of faulting on the outcrops, Geologic/geomorphic criteria for recognition of faults. Unconformity, types, recognition in field. Joints.

[**Lecture – 30**]

MJ-5/VUG-GEL (Practical) – 100 ESE

1. Basic idea of topographic contours
2. Geological cross section of maps and interpretation.
3. Structural contouring and 3-point problems of dip and strike.
4. Determination of dip, strike, plunge, etc. through stereo net.
5. Record & Viva-voce.

Books Recommended:

1. Ramsay, J.G. (1967) Folding and fracturing of rocks. McGraw-Hill, New York
2. Jain, A.K., (2014) An introduction to structural geology. Text Book series in GeologicalSciences for Graduate Students. Geological Society of India, Bangalore.
3. Billings, M.P., (1972) Structural Geology. Prentice Hall.
4. Davis, G.R., (1984) Structural Geology of Rocks and Region. John Wiley
5. Singh, R. P., (1995) Structural Geology: A Practical Approach. Ganga Kaveri Publ., Varanasi
6. Hills, E.S., (1963) Elements of Structural Geology. Farrold and Sons, London.
7. Structural Geology (2010) – Hakkon Fossien, Cambridge.

Semester - IV

Igneous Petrology – 4 Credits – 100 Marks – MJ-6/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

On completion of the course the students will have gained an understanding of the processesinvolved in the formation of igneous and metamorphic rocks, their textures, structures, classifications and their importance. Petrology is the science of rocks. The course will help the students to exhibit an improved understanding of fundamental petrologic processes and common rock types. Students learn to identify, describe and classify rocks using hand specimens. The students will also acquire skills to determine and interpret geochemistry of rocks.

Course content:

Magma- its nature and composition. Form and structure of igneous rocks. Texture of igneous rocks. Classification of igneous rocks. Bowen's reaction series and its significance. Magmatic differentiation and assimilation.

[**Lecture – 30**]

Concept of Phase diagrams; Crystallization of unicomponent and bicomponent (immiscible and solid solution) magma. Magmatism in the oceanic domains (MORB, OIB), Magmatism along the plate margins (Island arcs/continental arcs); Petrographic notes on granite, granodiorite, diorite, rhyolite, trachyte, syenite, gabbro, basalt, dolerite, anorthosite, dunite and pyroxenite.

[**Lecture – 30**]

Metamorphic Petrology – 4 Credits – 100 Marks – MJ-7/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course content:

Metamorphism - definition, agents and types. Texture and structure of metamorphic rocks. Basic concepts of zone, grade and facies. ACF, AKF, AFM diagrams; Prograde, retrograde and polymetamorphism; Thermal metamorphism of calcareous rocks. Progressive regional metamorphism of argillaceous rocks. Petrographic notes on shale, slate, phyllite, schist, gneiss, quartzite, marble, amphibolite and charnockite.

[**Lecture – 60**]

MJ-8/VUG-GEL (Practical) – 100 ESE

1. Identification of metamorphic minerals under microscope.
2. Identification of metamorphic rocks in hand specimen.
3. Plotting of Minerals in ACF and AKF Diagram.
4. Megascopic study of important igneous rocks.
5. Microscopic study of common igneous rocks.
6. Geological field work for 7 days in an igneous and metamorphic terrain.
7. Practical record & viva-voce.

Books Recommended:

1. Ram S. Sharma (2016) Metamorphic Petrology Concepts and Methods. Text BookSeries, Geological Society of India, Bangalore
2. Bose M.K. (1997) Igneous Petrology. The World Press Pvt. Ltd. 568 p.
3. Ehlers, WG, and Blatt, H.(1987) Petrology, Igneous, Sedimentary and Metamorphicrocks, CBS Publishers
4. Turner, F.J., (1980) Metamorphic petrology. McGraw Hill.
5. Mason, R., (1978) Petrology of Metamorphic Rocks. CBS Publ.
6. Winkler, H.G.C., (1967) Petrogenesis of Metamorphic Rocks. Narosa Publ.
7. Best M.G. Igneous and Metamorphic Petrology, Blackwell Publications
8. Blatt H., Tracy R.J. and Owens B.E. (2006) Petrology – Igneous, sedimentary andMetamorphic rocks (3rdEdition), W.H. Freeman and Company, New York.
9. Hatch F.H., Wells A.K and Wells M.K. (1984) Petrology of the igneous rocks. CBSPublishers, 551 p.
10. Winter J. D. (2001) An Introduction to Igneous and Metamorphic Petrology, PrenticeHall, 697p
11. Rollinson, H. (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
12. Philpotts, A. and Ague, J. (2009). Principles of igneous and metamorphic petrology.Cambridge University Press.
13. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill Science Engineering

Third year – Bachelor's Degree

Semester - V

Sedimentary – 4 Credits – 100 Marks – MJ-9/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Students will be able to identify primary sedimentary structure and their depositional environments, texture of rocks and understanding the economic deposit formed by sedimentary process. Students learn to identify, describe and classify rocks using hand specimens. The students will also acquire skills to determine and interpret geochemistry of rocks.

Course content:

Formation of sedimentary rocks. Lithification and diagenesis. Classification of sedimentary rocks. Structures of sedimentary rocks and their significance. Determination of top and bottom of sedimentary beds. Textures of sedimentary rocks. Concept of Provenance- mobility of oxides, stability of minerals and significance of light and heavy minerals. Petrographic notes on sandstones, arkose, shale, conglomerate, breccia, limestone and dolomite.

[**Lecture – 60**]

Geochemistry – 4 Credits – 100 Marks – MJ-10/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

End Semester Examination (ESE 75 marks)

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Students will learn to identify, describe and classify rocks using hand specimens. The students will also acquire skills to determine and interpret geochemistry of rocks.

Course content:

History of Geochemistry. Universe – nature, age and composition. Solar system – nature and origin. Meteorites: cosmic abundance of the elements. Structure and composition of the Earth. Geochemical classification of the elements. Structure of silicates. Isomorphism, polymorphism: Atomic substitution.

[**Lecture – 30**]

Isotopes – oxygen isotopes, carbon isotopes, Radioactive decay, Half-life, dating by radioactive nuclides – C-14, Uranium-lead method and Potassium-argon method, geochemical cycle.

[**Lecture – 30**]

MJ-11/VUG-GEL (Practical) – 100 ESE

1. Sedimentary structures, data collection & palaeocurrent analysis.
2. Megascopic and Microscopic study of sedimentary rocks.
3. Types of geochemical data analysis and interpretation of common geochemical plots.
4. Geochemical variation diagrams and its interpretations
5. Record and viva-voce

Books:

1. Brian Mason and Moore, C. B. 1985 - Principles of Geochemistry, Wiley
2. Sengupta S.M. (2007) Introduction to Sedimentology (2nd Edition), CBS Publishers and Distributors, New Delhi.
3. Boggs S., Petrology of Sedimentary rocks (2nd edition), Cambridge University Press.
4. Greensmith J. (1989) Petrology of the Sedimentary rocks (7th Edition), CBSPublishers, New Delhi.
5. H. Blatt, G. Middleton and R. Murray (1980) Origin of sedimentary rocks, PrincetonHall.
6. Tucker, M. E. (2006) Sedimentary Petrology, Blackwell Publishing

Semester - VI

Stratigraphy – 4 Credits – 100 Marks – MJ-12/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

The study of stratigraphy and Palaeontology encompasses the aspects of the age of the earth,chronological arrangement of rocks and appearance and evolution of life through the geologic time. The knowledge of the concepts in stratigraphy, correlation, and paleontology would enable the students to understand the changes that occurred in the history of the earth and relate them to their field observations and also, in understanding the framework of the stratigraphy of India. Stratigraphy and Paleontology, the two branches of Geology work together to unearth the secrets of age from rocks of the earth's crust. Stratigraphers study the composition and arrangement of layered or stratified rocks. Palaeontologists study the remains of plants and animals which have been preserved in the earth's crust by natural processes. With these objectives in mind it

becomes pertinent to understand the basic concepts of Stratigraphy and Palaeontology. The students will be exposed to the principles of stratigraphy including order of superposition. They will also be able to identify primary sedimentary structure and their depositional environments.

Course content:

Principles of stratigraphy. Fundamentals of litho-, bio- and chrono-stratigraphy and stratigraphic correlation. Geological time scale. Classification, lithological characteristics, fossil contents and economic importance of the following: Precambrian of Singhbhum, Cuddapah, Vindhyan Supergroup of Central India, Gondwana sequence of India with special reference to coal bearing formations, Lower Palaeozoic of Himalaya, Deccan Trap and Tertiary of Assam.

[**Lecture – 60**]

Palaeontology – 4 Credits – 100 Marks – MJ-13/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome

Palaeontologists study the remains of plants and animals which have been preserved in the earth's crust by natural processes. With these objectives in mind it becomes pertinent to understand the basic concepts of Stratigraphy and Palaeontology. The students will be exposed to the principles of stratigraphy including order of superposition. They will also be able to identify several fossils group and their depositional environments.

Couse content:

Definition of Fossils. Mode of preservation and uses of fossils. Classification, morphology and geological history of the following: Brachiopoda, Palecypoda, Gastropoda and Trilobita. A brief study of Gondwana flora and siwalik vertebrates.Evoution of horse. Human evolution. Morphological characteristic and geological age of the following: Spirifer, Terebratula, Rhynchonella, Productus, Arca, Cardita, Unio, Murex, Natica, Voluta, Conus, Glossopteris, Gangamopteris, Vertebraria.

[Lecture – 60]

Photogeology – 4 Credits – 100 Marks – MJ-14/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Couse content:

Elementary idea of photo geology. Types and acquisition of aerial photographs. Types of aerial cameras and flight planning. Human eye and stereoscopic vision, depth perception. Stereoscopes - their types, construction and function. Geometric characteristics of aerial photographs. Scale of the photographs, stereoscopic parallax. Elements of aerial photo interpretation. Identification of sedimentary igneous and metamorphic rocks and various aeolian, glacial, fluvial landforms.

[**Lecture – 60**]

MJ-15/VUG-GEL (Practical) – 100 ESE

1. Plotting of Geological formations on the map of India- showing distribution of - Dharwar Supergroup, Cuddapah Supergroup and Vindhyan Supergroup. Study of important rock types of the above mentioned stratigraphic units.
2. Study of morphological characters of about 30 genera pertaining to trilobite, brachiopods, pelecypods, gastropods, cephlopoda and plant fossils.
3. Interpretation of aerial photographs
4. Determination of scale of the photographs and images

5. Height measurement using parallax bar.
6. Geological field work for one week in a coal or metal mines.
7. Record and viva-voce.

Books Recommended:

1. Wadia, D., (1973) Geology of India. McGraw Hill Book co.
2. Krishnan, M.S., (1982) Geology of India and Burma, 6th Edition. CBS Publ.
3. Ramakrishnan M, and Vaidynadhan, R (1994) Geology of India, Geological Society of India Publication, Bangalore. Vol. I &II.
4. Friedman & Sanders, (1978) Principles of Sedimentology. John Wiley and sons.
5. Pettijohn F.J. (1984) Sedimentary Rocks (3rd Edition), CBS Publishers and Distributors, New Delhi.
6. Ravindrakumar (2018) Fundamentals of Historical Geology and Stratigraphy of India, Newage Publications.
7. Demers, M.N., 1997. Fundamentals of Geographic Information System, John Wiley & Sons. Inc.
8. Jensen, J.R., 1996. Introductory Digital Image Processing: A Remote Sensing Perspective, Springer- Verlag.
9. Lillesand, T. M. & Kiefer, R.W., 2007. Remote Sensing and Image Interpretation, Wiley.
10. Richards, J.A. and Jia, X., 1999. Remote Sensing Digital Image Analysis, Springer-Verlag
11. Fundamental of Remote Sensing & GIS – S. K. Sinha
12. Cowen, R. (2000) History of Life, Blackwell Science.
13. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science
14. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press
15. Michael Benton, (2005) Vertebrate Palaeontology, *Blackwell Publishing*
16. Patrick Wyse Jackson, (2019) Introducing Palaeontology: A Guide to Ancient Life,Dunedin Academic Press Ltd.
17. Raymond Enay (2012) Palaeontology of Invertebrates, Springer-Verlag.
18. Peter Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.
19. Morley Davies (2008) An Introduction to Palaeontology, Read Books.
20. Sreepat Jain (2017) Fundamentals of Invertebrate Palaeontology: Macrofossils,Springer India
21. Roland Goldring, (2014) Field Palaeontology, Routledge
22. Michael Benton, David A. T. Harper, (2009) Introduction to Paleobiology

and theFossil Record, Wiley-Blackwell.

23. Colbert, E.H. and Minkoff, Eli C. (2001) Evolution of vertebrates, Wiley Liss

Fourth year – Bachelor's Degree with Hons.

Semester - VII

Environmental Geology and Mathematical Geology – 4 Credits – 100 Marks

MJ-16/VUG-GEL [(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Know the basic fundamentals of earth science as applied to the interaction between human activity and the natural environment. Understand the occurrence and availability of both surface and subsurface water resources and the role of the hydrologic cycle and pollution. Understand the role of plate tectonics in causing earthquakes and how this understanding can aid the assessment of seismic hazard. This course deals with water and its pollution and geogenic disasters. Students will be able to test and evaluate water quality for drinking and agricultural use. They will also have knowledge about various natural disasters. Students will learn the application of mathematics in Geology.

Course content:

<u>Environmental Geology</u>

Definition and dimensions of environment; General idea about components and composition of different environmental domains such as atmosphere, hydrosphere and biosphere; Types of environmental pollution; Introduction to weather and climate; Past-climates in the earth history; Concept and origin of monsoon; Elements of natural hazards.

[**Lecture –27**]

Definition and concept of environmental geology. Processes of soil formation, types of soil, soil degradation and mitigation. Environmental changes due to the influence of geological events. volcanoes, earthquakes, floods and anthropogenic activities. Environmental degradation due to mining and related activities and remedies. Water and air pollution.

[**Lecture – 27**]

Mathematical Geology

Application of statistics, trigonometry, algebra and calculus in Geology.

[**Lecture – 06**]

Engineering Geology – 4 Credits – 100 Marks– MJ-17/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Upon completion of the course the student will become aware of the importance of geological studies and its applicability to various engineering problems. To impart sufficient knowledge of engineering geology so as to be able to anticipate the technical problems related to geology of various engineering sites and suggests possible remedial measures. The student will be educated on geological site investigations for engineering structures and will provide skills in geological mapping and making geotechnical measurements.

Couse content:

Engineering properties of rocks, laboratory testing of rocks – uniaxial compressive strength, tensile strength, shear strength, Mohr's diagram: mass movement- classification and causes". Dam – its type, geotechnical consideration, selection of sites, forces acting on a dam.

Reservoirs – geological investigation, silting of reservoirs. Tunnel – geological investigations in tunnelling. Case histories related to Indian civil Engineering projects.

[**Lecture – 60**]

Economic Geology – 4 Credits – 100 Marks – MJ-18/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

Students will learn identification of ores in hand specimen as well as the process of formation of ores. They will also get the knowledge of ore deposits in geological formations.

Course content:

Definition of ore, ore minerals, gangue minerals, tenor of ore, mineral reserves and mineral resources. Processes of formation of mineral deposits with special reference to Magmatic concentration, Hydrothermal processes, Supergene sulphide enrichment and Mechanical concentration.

[**Lecture – 30**]

Study of physical properties, chemical composition and uses of following minerals: Galena, Sphalerite, Chromite, Graphite, Asbestos, Kyanite, Sillimanite, Cassiterite, Chalcopyrites, Heamatite, Baryl, Barite, Uraninite, Monazite, Corundum; Elementary idea regarding origin, uses and distribution of coal and petroleum in India.

[**Lecture – 30**]

MJ-19/VUG-GEL (Practical) – 100 ESE

1. Recognition of Dam site through geological map.
2. Ore identification in hand specimen.
3. Plotting of important ore deposits in map of India
4. Reserve calculation of ore
5. Practical record and viva-voce

Books Recommended:

1. Valdiya, K. S., (1987) Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.
2. Keller, E. A., (2000) Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.
3. Montgomery, C., (1984) Environmental Geology. John Wiley and Sons, London.
4. Sharma J. P., Environmental Studies, Laxmi Publications (P) Ltd, New Delhi
5. Blyth, F.G.H. and M. H. de Freitas(1984)Geology for Engineers, Butterworth-Heinemann Title
6. Krynine, D.P and Judd, W.R (2005) Principles of Engineering Geology and Geotechniques, CBS Publishers & Distributors
7. Ries, H. and T. L. Watson, (1949) Elements of Engineering Geology, New York, JohnWiley & Sons, Inc.
8. Krynine, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill.
9. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley
10. Goodman, R.E., 1993. Engineering Geology: Rock in engineering constructions. John Wiley & Sons, N. Y.
11. Engineering and General Geology - Parbin Singh.
12. Bell: F.G-, 2006. Basic Environmental and Engineering Geology Whittles Publishing.
13. Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
14. Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
15. Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.
16. Prasad, U. (2019). Economic Geology: Economic Mineral Deposits. CBS 2nd edition.
17. Mathematics in geology (2013) John Ferguson, Springer

Semester - VIII

Hydeogeology– 4 Credits – 100 Marks – MJ-20/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

On completion of the course, the student will have gained an understanding of hydrogeological concepts, exploration, exploitation and recharge of groundwater and methods of monitoring groundwater quality and sources of pollution. To impart knowledge about groundwater, its movement, methods of its exploration, the criteria of its quality, methods of its conservation, recharge of groundwater monitoring of groundwater quantity and quality. Students will be able to acquire skills of systematic hydrogeological surveys and water quality monitoring

Course content:

Introduction and basic concepts of hydrogeology and its scope; Hydrological cycle. precipitation, evapo-transpiration, run-off, infiltration and subsurface movement of water. Rock properties affecting groundwater, Vertical distribution of subsurface water. Types of aquifer, aquifer parameters, porosity, specific yield, specific retention, permeability, transmissivity, storavity. anisotropy and heterogeneity of aquifers.

[**Lecture – 30**]

Groundwater flow Darcy's law, its validity. Intrinsic permeability and hydraulic conductivity. Surface-based groundwater exploration methods. Groundwater chemistry-physical and chemical properties of water and water quality, Sea water intrusion in coastal aquifers. Groundwater level fluctuations, Rainwater harvesting and artificial recharge of groundwater

[**Lecture – 30**]

Remote Sensing & GIS– 4 Credits – 100 Marks– AMJ-1/VUG-GEL

[(ESE-75) + (SIE -20) + (D to D-5)]

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

The course is meant to address the fundamental techniques used for remote sensing. At the end of this course, the student will be appraised with all the theoretical knowledge, information and skills to use Remotely Sensed data for geological applications. This course intends to introduce students to the fundamental principles and techniques of remote sensing, basic properties of electromagnetic radiation and its interaction with matter, It will also include topics like instruments and platforms used for remote sensing, and the ways those systems can be used to determine geological structure and rock types. After completion of this course, the student will be well versed with the world of Remote Sensing and the applications and Interpretation of data related to geosciences.

Course content:

Concept in remote sensing. General idea of electromagnetic spectrum, signature of common natural objects. Radiation laws. Interaction of EMR with the earth's surface and with the atmosphere. Platform and sensors. Multi-spectral scanners. Resolution of sensor- Spatial, Spectral, Radiometric and Temporal. Satellites and their characteristics. Microwave remote sensing. Digital image processing technique. Application of remote sensing in geology, mineral exploration, groundwater and hydrocarbon exploration.

[**Lecture – 40**]

Principles of Geographic information System(GSI), data structure, data accqusition, retrieval, overlay operation and application of GSI. Concept of GPS. Application in earth science system.

[**Lecture – 20**]

Mining, Ore dressing and Mineral exploration– 4 Credits – 100 Marks – AMJ-2/VUG-GEL; ([ESE-75] + [SIE -20] + [D to D-5])

There will be two groups of question.

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each. Group A will be compulsory.

Group B will contain 7 long answer type questions of 15 marks each in which 4 have to be attempted.

Course learning outcome:

The course provides the student essential and basic concepts of mineral expiration techniques and the art and science of mining mineral resources. The curse envisages to expose the students to the topics such as geology in mining industry, methods of exploration, Sampling Principle, Methods, estimation of reserves, Ore Dressing and Beneficiation. This course tries to impart skills related to Geology in mining and enable him/her to performduties of a geologist at the mining site.

Course content:

<u>Mining</u>

Shaft, Hanging and footwall, Adit, Drive, Crosscut, Raise, Winze, Chute, Open cast Mining, Basic idea of Dragline, Power Shovel, Scrapers.

Underground Mining- Open stopes (Grophering, Breast stoping, Open Under hand stoping, Underground glory hole, Room and Piller),Supported Stopes (Overhand Stoping Method with supports, timbered stopes), Filled Stopes (Cut and Fill method, Horizontal-cut and fill stopes, Baltic dry wall method, Cross-cut method, Inclined-cut Method), Shrinkage stopes.

[**Lecture – 20**]

Mineral Beneficiation(Ore Dressing)- Preparation of the mineral samples for dressing, crushing, screening, grinding, sizing, concentration, storage. Gravity Separation, Heavy Media Separation, Jigging, Tabling, Magnetic Separation, Electrostatic Separation, Floatation Collector, Frothers, Modifiers, Agglomleration.

[**Lecture – 20**]

Mineral Exploration

Techniques of Mineral Exploration: Reconnaissance survey, Geological mapping, prospecting method. Basic idea of Geological Exploration, Geophysical Exporation and Geochemical Exploratioln, Sampling and Sampling method. Reserve Estimation.

[**Lecture – 20**]

Practical– 4 Credits – 100 Marks ESE- AMJ-3/VUG-GEL

1. Aerial photo/image interpretation, identification of sedimentary, igneous and metamorphic rocks.
2. Identification of structural features in aerial photo/ satellite imagery.
3. Identification of geomorphic features in aerial photo/ satellite imagery.
4. Completion of Outcrop Map.
5. Reserve Calculation.
6. Field work for one week.
7. Record and viva-voce.

Books Recommended:

1. Arogyaswamy R.N.P. (1973) Courses in Mining Geology, Oxford and IBH PublishersCo. Ltd., 916 pages
2. Sinha R. K. and Sharma N. L. (1989)Mineral Economics, Oxford and IBH PublishersCo. Ltd, 4th Edition, 410 pages
3. McKinstry H. E.(1980)Mining Geology, Prentice Hill Inc., 667 pages.
4. Babu S. K. and Sinha D. K.(1988)Practical Manual of Exploration and Prospecting,CBS Publishers and Distributors, New Delhi
5. Sharma J. P.(2009) Environmental Studies, Laxmi Publications (P) Ltd, New Delhi,Indian Bureau of Mines publications
6. Krieter, V. M. (2004) Geological prospecting and exploration, University Press ofPacific.
7. Dobrin, M. B. (1960) Geophysical prospecting, McGrath Hill.
8. Todd, D.K. and Mays, L.W. (2004) Groundwater Hydrology, John Wiley & Sons.
9. Karanth, K.R. (1987) Groundwater Assessment Development and Management,Tata McGraw-Hill Education.

10. Raghunath, H.M. (1987) Groundwater,New Age International
11. Davis, S.N. and Dewiest R.J.M. (1966) Hydrogeology, John Wiley & Sons.
12. Freeze, R. A. and Cherry, J. A. (1979) Groundwater, Prentice Hall
13. Hiscock, K. M. (2005) Hydrogeology: Principles and Practice, Blackwell Publishing
14. Kresic, N. (1997) Hydrogeology and Groundwater Modeling, Lewis Publishers
15. Brassington, R. (2017) Field Hydrogeology, Wiley Blackwell
16. Hudak, P. F. (1999) Principles of Hydrogeology, Lewis Publishers
17. Pawar, N.J, Das, S. And Duraiswami R.A (2012) Hydrogeology of Deccan Traps and associated Formations in Peninsular India, Geol. Soc. India, Bangalore.
18. Das Subhajyoti (2011) Groundwater Resources of India. National Book Trust. 1stEdition, 248 p.
19. Rose, Howkes and Webb (1979) Geochemistry in mineral exploration, Academic Press
20. Miller Victor C. Miller Calvin F. (1961) Photogeology (International Series in theEarth Sciences. McGraw-Hill Book Company, Inc.
21. Drury S.A, A Guide to Remote Sensing - Interpreting Images of Earth, Oxford SciencePublications, Oxford. (1990)
22. Sabins, F.F.Jr., (1978) Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco.
23. Paine, D.P (1981) Aerial photography and image interpretation for resource management,Wiley and Sons, New York. 1986.
24. Gary L. Prost Remote Sensing for Geologists - A Guide to Image interpretation, Gordon and Breach Science Publishers, The Netherlands. 1997.
25. Reddy A. (2012) Introduction to Remote Sensing and GIS, BS Publications.
26. Fundamental of Remote Sensing and GIS – S. K. Sinha
27. Ramasamy, SM. (1999) Trends in Geological Remote Sensing - Rawat Publishers, Jaipur

DEPARTMENT OF GEOLOGY

VINOBA BHAVE UNIVERSITY, HAZARIBAG

NEP 2020 SYLLABUS

Minor – MN

Semester Internal Examination (SIE 10 + 5)

The semester internal examination shall have two components

a) One semester internal assessment written test of 10 marks.

b) Class Attendance Score (CAS) including the behavior of the students towards teacher and other students of the college of 5 marks.

End Semester Examination (ECS 60 marks)

There will be two group of question

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each.

Group A will be compulsory.

Group B will contain 5 long answer type questions of 15 marks each in which 3 have to be attempted.

Semester-I

[Physical, Crystallography, Optical, descriptive mineralogy] - MN-1A/VUG-GEL

Credits -3 [(ESE-60) + (SIE -10) + (D to D-5)]

Course learning outcome:

The course provides the student essential and basic concepts of crystallography, mineralogy and understanding the earth. Students will also learn identification of minerals.

Physical Geology

The nature and scope of geology; Origin of the Earth; Age of the Earth; An elementary idea of seismic waves and interior of the Earth; Geological work of river and Wind.

[**Lecture – 10**]

Crystallography

Elementary ideas about crystal structure; Crystal: faces, edges, solid angles and interfacial angles; Crystallographic axes and axial angles; Elements of Crystal Symmetry. Parameter, indices and symbol. Laws of crystallography; Isometric System.

[**Lecture – 10**]

Optical Mineralogy

Nature of light; Polarization of light; Isotropic and anisotropic substances (minerals); Phenomenon of double refraction; Nicol prism – its construction; Construction and function of petrological microscope. Optical properties of Quartz, orthoclase, plagioclase, microcline, biotite, muscovite.

[**Lecture – 15**]

Descriptive Mineralogy

Mineral - definition; Physical properties of minerals; Structure and classification of silicates; Chemical composition and diagnostic physical properties of the following rock forming minerals - quartz, orthoclase, microcline, kyanite, calcite, gypsum, apatite, talc, fluorite, garnet, biotite, muscovite, beryl.

[**Lecture – 10**]

MN-1A/VUG-GEL, Credit (1)- [ESE-25] - Practical

1. Crystal drawing of the following forms- cube, Octahedron, Dodecahedron
2. Identification of rock forming minerals in hand and under microscope.
3. Record and viva-voce

Books:

1. Principles of physical geology- Holmes.
2. Geomorphology- P. Dayal.
3. Principles of Geomorphology- Thornbury. W. D.
4. Elements of crystallography and mineralogy Wade & Mattox.
5. Phillips, F.C. (1971): Introduction to Crystallography, Longman Group Publ.
6. Rutleys Elements of Mineralogy, CBS Publication.

Semester-III

Structural and Petrology - MN-1B/VUG-GEL- 3 Credits

[(ESE-60) + (SIE -10) + (D to D-5)]

End Semester Examination (ECS 60 marks)

There will be two group of question

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each.

Group A will be compulsory.

Group B will contain 5 long answer type questions of 15 marks each in which 3 have to be attempted

Course learning outcome:

The course provides the essential and basic concepts of Structure Geology and Petrology. Students will learn basic concept of deformation of rock and identification of different type of rock.

Course content:

Structural Geology

Understanding dip and strike. Construction and uses of Clinometer and Brunton compass; Elementary idea and nomenclature of Folds, Faults, Unconformity and Joints.

[**Lecture – 20**]

Petrology

Igneous Rocks - Definition and classification of igneous rocks; Forms of igneous bodies; Brief petrographic description of common igneous rocks such as – granite, gabbro, dolerite, basalt, rhyolite. Sedimentary rocks – texture and structure; Brief Petrographic descriptions of common sedimentary rocks such as – conglomerate, breccia, sandstone, limestone and shale. Metamorphic rocks – definition, types and its agents; Textures of metamorphic rocks; Brief Petrographic descriptions of common metamorphic rocks – slate, phyllite, schist, gneiss, marble and quartzite.

[**Lecture – 25**]

Books:

1. Davis, G. R. (1984) Structural Geology of Rocks and Region. 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. Petrology – G. W. Tyrell
5. Petrology – Ehlers and Blatt
6. Sedimentary petrology – Tucker M. E.

MN-1B/VUG-GEL (Practical) 1 Credit, ESE - 25

1. Study of simple geological maps from No 1 to 8 involving simple Dip, Fold, Fault and Unconformity, drawing of geological sections and detailed geological description.
2. Identification of igneous, sedimentary and metamorphic rocks in hand specimen.
3. Record and viva-voce

Semester-V

Engineering +Stratigraphy + Paleontology – MN-1C/VUG-GEL- 3 Credits

[(ESE-60) + (SIE -10) + (D to D-5)]

End Semester Examination (ECS 60 marks)

There will be two group of question

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each.

Group A will be compulsory.

Group B will contain 5 long answer type questions of 15 marks each in which 3 have to be attempted.

Course learning outcome:

The course provides the essential and basic concepts of dam, tunnel and engineering works. They will also learn science of strata and fossils.

Course content:

Stratigraphy

Stratigraphy**:** Principles of stratigraphy. Geological time scale. A brief account of the important geological formation of India viz. Precambrian of Jharkhand, Gondwana Supergroup of Jharkhand and Vindhyan Supergroup.

[**Lecture – 15**]

Engineering Geology

Engineering properties of rock; Geological, geotechnical and environmental considerations for Dams and Reservoirs. Tunnels and Tunneling Methods. Landslides; Causes, Factors and corrective/preventive measures. Earthquakes; causes, role of Engineering geologists in planning, design and construction of major structural features.

[**Lecture – 15**]

Palaeontology

Palaeontology: Definition and its scope; Fossils definition, their mode of preservation and uses; Morphology and geological history of the following: Brachiopoda, Palecypoda and Trilobita.

[**Lecture – 15**]

Books:

1. Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
2. Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.
3. Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.
4. Engineering and Geology – Parbin Singh

MN-1C/VUG-GEL (Practical), Credit 1, ESE-25

1. Identification of important invertebrate and plant fossils
2. Record and viva-voce.

Semester-VIII

Economic Geology and Hydrogeology – MN-1D/VUG-GEL-3 Credits

[(ESE-60) + (SIE -10) + (D to D-5)]

End Semester Examination (ECS 60 marks)

There will be two group of question

Group A will be of very short answer type (consisting Five objective types excluding multiple choice questions) of 1 mark and two short answer type of 5 marks each.

Group A will be compulsory.

Group B will contain 5 long answer type questions of 15 marks each in which 3 have to be attempted.

Course learning outcome:

The course provides the essential and basic concepts of ground water flow and their retention in rocks. Students will also understand the economic mineral deposits.

Course content:

Economic Geology

Definition of ore, ore minerals, gangue minerals, tenor of ore; processes of formation of mineral deposits – magmatic concentration and placer deposits; Mode of occurrence and distribution of metallic and non-metallic mineral deposits – Iron, Copper, Coal deposits of Jharkhand; Physical properties of chalcopyrite, pyrite, galena and hematite.

[**Lecture – 25**]

Hydrogeology

Occurrence and vertical distribution of groundwater; Hydrological cycle; Water bearing properties of rocks - Porosity and permeability, Specific yield, specific retention and storage coefficient. Aquifers and their types.

[**Lecture – 20**]

Books:

1. Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
2. Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
3. Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.
4. Prasad, U. (2019). Economic Geology: Economic Mineral Deposits. CBS 2nd edition.
5. Valdiya, K.S. (1987): Environmental Geology – Indian Context, Tata McGraw Hill.
6. Todd, D. K. (1995): Groundwater hydrology, John Wiley and Sons.

MN-1D/VUG-GEL (Practical), credit -1, ESE-25

1. Megascopic identification of following ores-Chalcopyrite, Cuprite, Galena, Sphalerites, Heamatite, Magnetite, Pyrite.
2. Plotting of important ore deposits in the political map of India.
3. Record and viva-voce