RAJA MAHENDRA PRATAP SINGH UNIVERSITY
ALIGARH

SYLLABUS FOR

BACHELOR OF SCIENCE (HONOUR'S),

BACHELOR OF SCIENCE (HONOUR'S WITH RESEARCH) 4TH Year

&

MASTER OF SCIENCE (5TH Year)

IN GEOLOGY

{Effective from the academic session 2025-26}

BACHELOR OF SCIENCE (HONOURS) & BACHELOR OF SCIENCE (HONOURS WITH RESEARCH) IN GEOLOGY (FOURTH YEAR)						
YEAR	**SEM**	**COURSE CODE**	**PAPER TITLE**	**THEORY/PRACTICAL**	**CREDIT**	**TOTAL**
4TH YEAR	VII	RB090701T	ADVANCED MINERALOGY	THEORY	4	20/16
		RB090702T	STRUCTURAL GEOLOGY AND TECTONICS	THEORY	4	
			Choose both for B.Sc. (HONOUR'S) & choose one for B.Sc. (HONOUR'S with RESEARCH			
		RB090703T	I. IGNEOUS PETROLOGY	THEORY	4	
		RB090704T	II. GEOCHEMISTRY	THEORY	4	
		RB090705P	PRACTICAL LAB WORK	PRACTICAL	4	
	VIII	RB090801T	GEOMORPHOLOGY AND REMOTE SENSING	THEORY	4	20/24
		RB090802T	SEDIMENTOLOGY	THEORY	4	
			Choose both for B.Sc. (HONOUR'S) & choose one for B.Sc. (HONOUR'S with RESEARCH)			
		RB090803T	I. METAMORPHIC PETROLOGY	THEORY	4	
		RB090804T	II. ECONOMIC AND MINING GEOLOGY	THEORY	4	
		RB090805P	PRACTICAL LABWORK AND FIELD WORK	PRACTICAL	4	
		RB090806R	RESEARCH PROJECT		8	

MASTER OF SCIENCE IN GEOLOGY (FIFTH YEAR)						
YEAR	SEM	COURSE CODE	PAPER TITLE	THEORY/PRACTICAL	CREDIT	TOTAL
5TH YEAR	IX	RB090901T	APPLIED PALAEONTOLOGY	THEORY	4	16
		RB090902T	ENGINEERING GEOLOGY	THEORY	4	
			Choose any one:			
		RB090903T	FUEL GEOLOGY	THEORY	4	
		RB090904T	INDIAN STRATIGRAPHY	THEORY	4	
		RB090905P	PRACTICAL LAB WORK	PRACTICAL	4	
	X	RB091001T	HYDROGEOLOGY	THEORY	4	24
		RB091002T	GEOPHYSICS	THEORY	4	
			Choose any one: CLIMATOLOGY			
		RB091003T	ENVIRONMENTAL AND MEDICAL	THEORY	4	
		RB091004T	GEOLOGY	THEORY	4	
		RB091005P	PRACTICAL LAB WORK	PRACTICAL	4	
		RB091006R	RESEARCH PROJECT		8	

PAPER TITLE: ADVANCED MINERALOGY

Course Code	RB090701T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Seven/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

A comprehensive study of the different silicate mineral groups (listed below) with reference to general and structural formulae, atomic structure, elemental substitution, composition and classification, properties, pressure-temperature stability, modes of occurrence and alterations:
Nesosilicates/Orthosilicates: Olivine Group, Garnet Group, Aluminosilicate Group, Zircon; Sorosilicates: Epidote Group; Cyclosilicates: Beryl, Tourmaline; Inosilicates; Pyroxene Group; Amphibole Group; Phyllosilicates: Clay minerals, Mica Group, Chlorite, Serpentine; Tectosilicate: Quartz, Feldspar, Feldspathoid, Zeolite minerals.

UNIT-II

External and internal symmetry, types of symmetry possible in minerals, 32 crystals classes and description of the different classes; concept of Space groups; Miller indices; Hermann Mauguin notation, Different types of crystal projections-spherical and stereographic projections and their uses, Twinning in crystals, Laws of twinning, common types of twins and their examples in minerals.

UNIT-III

Behaviour of light in minerals, Double refraction, Optic axis, Uniaxial and biaxial minerals, Retardation, Birefringence, Interference of light, Interference colour, Order of Interference colour, Michael Levy's chart, determine birefringence, Optical Indicatrix: uniaxial and biaxial indicatrix, Scheme of pleochroism, Optical accessory plates (mica, gypum and quartz), Sign of elongation, Conoscopic and orthoscopic light view, Interference figure: Isogyre, isochromes, melatope; Determination of Optic sign.

UNIT-IV

Mineral stability with emphasis on solid solution, Polymorphism and Isomorphism; crystal defects and chemistry: colour, cause and enhancement techniques, thin section preparation for mineral studies. and Geological application of following; Atomic Absorption Spectrophotometry, Scanning Electron Microscopy and X-ray diffraction techniques.

Text & Reference Books

1. Berry, L.G., Mason, B. and Dietrich, R.V. (1982). Mineralogy, CBS Publ.
2. Dana, E.S. and Ford, W.E. (2002). A textbook of Mineralogy (Reprint).
3. Deer, W. A., Howie, R. A. and Zussman, J. (1966). An Introduction to the Rock-Forming Minerals. The Mineralogical Society, London.
4. Flint, F. (1964). Essentials of Crystallography. Peace Pub., Russia.
5. Kerr, P.F. (1977). Optical Mineralogy. McGraw Hill.
6. Moorhouse, W.W. (1951). Optical Mineralogy, Harper and row Publ.
7. Nesse, D.W. (1991). Introduction to Optical Mineralogy, Oxford University
8. Nesse, D.W. (1999). Introduction to Mineralogy, Oxford University Press
9. Perkins, D. (1998). Mineralogy. Pearson Education
10. Phillips, F.C. (1971). Introduction to Crystallography. Longman Group Publ.
11. Sharma, R.S. and Sharma, A. (2013). Crystallography and Mineralogy. Geological Society of India.

PAPER TITLE: STRUCTURAL GEOLOGY AND TECTONICS

Course Code	RB090702T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Seven/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Stress and its components: Analysis of Stress in two and three dimension, Mohr Diagrams. Mechanical properties of rock: Strain Concepts; Strain Ellipsoid; Coaxial and non-axial deformation; method of Strain measurement in naturally deformed rocks; Theories of Rock failure; Modern concept on the mechanism.

UNIT-II

Fold and their Geometry, morphology and classification; Strain patterns in folds; superimposed folding; mechanics of folding-Geometry, Types, Genesis and significance of Lineation, Foliations and Cleavage. Faults: Classification, recognition and Genesis; Thrust Geometry, Mechanics of Thrust emplacement and nappes.

UNIT-III

The plate configuration of the Earth; Geomagnetic reversal, Geometry of Plate movement, Driving mechanisms of Plates Tectonics; recent evidences of plate tectonics, Dynamic evolution of Continental and Oceanic Crust.

UNIT-IV

Tectonic of Indian sub-continent, The Indian sub-continent in light of Plate tectonics; Structure tectonics and tectonic evolution of Himalaya, Tectonics of Precambrian Orogenic Belts of India, Tectonic framework of Indo-Gangetic Plain.

Text & Reference Books

1. Badgeley, P.C., 1965: Structure and Tectonics. Harper and Row.
2. Ramsay, J.G. 1967: Folding and Fracturing of Rocks. McGraw Hill.
3. Hobbs, B.E., Means, W.D. and Williams, P.F. 1976: An outline of structural Geology. John Wiley.
4. Davis, G.R., 1984: Structural Geology of Rocks and Region. John Wiley.
5. Ramsay, J.G. and Huber, M.I.., 1987: Modern Structural Geology, Vol. I & II Academic Press.
6. Price, N.J. and Cosgrove, J.W., 1990: Analysis of Geological Structure. Cambridge Univ. Press.
7. Bayly, B., 1992: Mechanics in Structural Geology. Springer Verlag.
8. Ghosh, S.K., 1995: Structural Geology, Fundamentals of Modern Developments. Pergamon Press.
9. Moores, E. and Twiss, R.J., 1995: Tectonics. Freeman.
10. Keary, P. and Vine, F.J., 1990: Global Tectonics. Blackwell.

PAPER TITLE: IGNEOUS PETROLOGY

Course Code	RB090703T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Seven/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Classification of Granitoids and high Mg volcanic rocks in the light of IUGS recommendations; Classification and composition of Meteorites including introduction to Lunar and Martian meteorites.

UNIT-II

Magma generation in the crust and mantle; mantle metasomatism; Mantle heterogeneities; Enriched and depleted mantle; Large Igneous Provinces and mafic dyke swarms with particular reference to Bushveld and Skaergaard complexes.

UNIT-III

Gibb's phase rule; Lever rule; Tangent Rule; Phase equilibria studies in the silicate systems: Periclase–Silica; Albite–Orthoclase–Water; Albite–Potash feldspar–Silica-Water; Diopside– Forsterite–Silica; and Nepheline-Kalsilite-Silica.

UNIT-IV

Petro-tectonic associations of rocks; Petrogenesis of Granite, Massif Anorthosite, Kimberlite, Lamprophyre, Komatiite, Basalt, Carbonatite, Ophiolite, Andesite with suitable Indian examples.

Text and Reference Books

1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.
2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.
3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.
4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
5. Gautam Sen, 2014. Petrology: Principles and Practice: Gautam Sen (Springer).
6. Best, M. G. 2013. Igneous and Metamorphic Petrology. Wiley Blackwell.
7. Don L. Anderson 2012 Theory of the Earth Blackwell Scientific Publications
8. Alexander R McBirney, 2006 Igneous Petrology, III edition: Alexander R McBirney

PAPER TITLE: GEOCHEMISTRY

Course Code	RB090704T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Seven/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Abundance of elements in Earth; Geochemical differentiation of the earth; Geochemical cycle; Chemical composition and characteristics of atmosphere, lithosphere, hydrosphere; geochemical cycles; Laws of Thermo-dynamics, Thermodynamic of non – ideal and dilute solution, Concept of free energy, activity, fugacity and equilibrium.

UNIT-II

Goldschmidt's classification of elements; fractionation of elements in minerals/rocks; Nernst's partition coefficient (compatible and incompatible elements), Nernst-Berthelot partition coefficient and bulk partition coefficient; Application of trace elements in petrogenesis; principles of equilibrium and Rayleigh fractionation; REE patterns,

UNIT-III

Half-life and decay equation; dating of minerals and rocks with potassium-argon, rubidium-strontium, uranium-lead and samarium-neodymium isotopes; petrogenetic implications of samarium-neodymium and rubidium-strontium systems**.**

UNIT IV

Stable isotope geochemistry of carbon, oxygen and sulphur and their applications in geology. Eh and pH diagrams and mineral stability.

Text and Reference Books:

1. Mason, B. and Moore, C.B. 1991: Introduction to Geochemistry, Wiley Eastern.
2. Krauskopf, K.B., 1967: Introduction to Geochemistry. McGraw Hill.
3. Faure, G., 1986: Principles of Isotope Geology. John Wiley.
4. Hoefs, J., 1980: Stable Isotope Geochemistry. Springer Verlag.
5. Marshal, C.P. and Fairbridge, R.W. 1999: Encyclopaedia of Geochemistry. Kluwer Academic.
6. Govett, G.J.S. (ed) 1983: Handbook of Exploration Geochemistry. Elsevier.
7. Nordstrom, D.K. and Munoz, J.L., 1986: Geochemical Thermodynamics, Blackwell.
8. Henderson, P., 1987: Inorganic Geochemistry. Pergamon Press.

PAPER TITLE: PRACTICAL [LAB WORK]

Course Code	RB090705P	Credit	4
L+T+P	0+0+4	Course Duration	One semester
Semester	Seven/ Odd	Contact hours	120 (P) Hours
Nature of the Course	Practical		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

1. Study of the physical properties of rock forming minerals in hand specimens, with special reference to their origin and distribution.
2. Study of the optical properties of rock forming minerals in thin sections.
3. Interpretation of Geological maps and sections; Structural problems using Stereographic methods.
4. Megascopic and microscopic study of important igneous rocks. Calculation of C.I.P.W. norms and Niggli values.

[Note: Every student shall be required to keep and maintain up-to-date record of practical work during the session, properly signed by the teachers concerned and submit it to the Head of the Department at the time of their Practical Examination.]

PAPER TITLE: GEOMORPHOLOGY AND REMOTE SENSING

Course Code	RB090801T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Eight/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Aims, Scope and basic concept of Geomorphology Geomorphic Cycle: Land forms, their types and development in relation to rock type, Structure and Tectonics: Mass Movements & Masswasting, Land Slides, Falls. Flows & Creep – Fluvial processes and related Land forms. Drainage basin analysis.

UNIT-II

Erosion, Transportation and Deposition by sea: Classification of costal Landforms: Shorelines- their classification and evolution, Landforms resulted by the action of Ground Water, Arid Geomorphology. Types of Glaciers, Glacial Motion, Law of Glacial Erosion, Erosional and Depositional features of Glaciers; Glacial Geomorphic Cycle; Concept of Ice age pre-glacial landscapes; A brief Geological account of important Himalayan Glaciers of present day. Evidence of glaciation in geological past.

UNIT-III

A pre-elementary knowledge about electromagnetic spectrum, aerial photographs and their geometry; photo-geometry, Satellite Remote Sensing, Global and Indian Space Missions. Different Satellite exploration programs and their characteristics: Landsat, Metoset, Seasat, Spot, IRS. Image interpretation and Digital processing techniques.

UNIT IV

Image characters and their relations with ground objects based on tones, texture and patterns. Evaluation of Ground Water Potential and rock type identification. Interpretation of photographs and tectonic features, Discrimination of Common land forms on Photos and Images, Principals and Applications of Geographic Information System.

Text and Reference Books:

1. Miller, V.C., 1961: Photogeology, McGraw Hill.
2. Sabbins, F.F., 1985: Remote Sensing – Principles and Applications, Freeman.
3. Ray, R.G., 1969: Aerial Photographs in Geologic Interpretations. USGC Prof. Paper 373.
4. Drury, S.A. 1987: Image Interpretation in Geology. Allen and Unwin.
5. Moffitt, F.H. and Mikhail, E.M., 1980: Photogrammetry, Harper and Row.
6. Lillesand, T.M. and Kieffer, R.W., 1987: Remote Sensing and Image Interpretation. John Wiley.
7. Paine, D.P. 1981: Aerial photography and Image Interpretation for Resource Management. John Wiley.
8. Pandey, S.N. 1987: Principles and Applications of Photogeology. Wiley Eastern, New Delhi.
9. Gupta, R.P. 1990: Remote Sensing Geology, Spring Verlag.
10. Thornbury Willium D.- Principles of Geomorphology.

PAPER TITLE: SEDIMENTOLOGY

Course Code	RB090802T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Eight/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT I

Origin of Sediments, Physical and Chemical Concept of Compositional and Textural maturity, Classification of Sandstones and Conglomerates in the light of recent researches, Digenesis of Mudstones and Sandstones, Chemistry of weathering processes, Flow regimes – ideal sequence of structure in flow regimes.

UNIT II

Origin, Hydrodynamic and Geologic significance of bedding, Planner and Trough Cross Bedding, Ripple Marks, Ripples Cross Laminations, Climbing Ripples Convolute Laminations, Sole Structure, Stromatolites. Erosional Channels and Geometry of Sandstone Bodies; Digenesis and Classification of Limestone, Formation of Phosphorite Deposits; Tectonic and Climate Signification of Arkose, Greywacke and Quartz Arenites.

UNIT III

Sedimentry Facies; Walther's Facies Law; Vertical Facies relationship and Facies models. Cylothems and their significance, Krynin's tectonic cycle and associate sediment types; Heavy minerals and their Sedimentologic significance; Dispersal pattern. Scaler and Vector properties of Sediments in reconstructing paleocurrent significance of Paleocurrents.

UNIT IV

Depositional Environment: Physical and Chemical parameters and geomorphic Classification; Environmental reconstruction and Facies model with ancient and recent example of Alluvial, Deltaic, Turbidite and Glacial environments. Evolution of Sedimentary Basins: Tectonics and Sedimentation, Classification viz plate tectonics, Basin Models: Divergent Basin, Rifts alacogens and Failed rift.

Text and Reference Books

1. Allen, J.R.I., 1985: Principles of Physical Sedimentation. George Allen & Unwin.
2. Allen, P. 1997: Earth Surface Processes. Blackwell.
3. Nichols, G. 1999: Sedimentology and Stratigraphy, Blackwell.
4. Reading, H.G. 1996: Sedimentary Environments. Blackwell.
5. Davis, R.A. Jr., 1992: Depositional Systems. Prentice Hall.
6. Einsele, G., 1992: Sedimentary Basins. Springer Verlag.
7. Reineck, H.E. and Singh, I.B., 1980: Depositional Sedimentary Environments. Springer Verlag.
8. Prothero, D.R. and Schwab, F., 1996: Sedimentary Geology, Freeman.
9. Miall, A.D., 2000: Principles of Sedimentary Basin Analysis. Springer-Verlag.
10. Pettijohn, F.J., Potter, P.E. and Siever, R. 1990: Sand and Sandstone. Springer Verlag.
11. Blatt, H. Murray, G.C. and Middleton, R.C., 1980: Origin of sedimentary Rocks.
12. Bhattacharya, A. and Chakraborti, C., 2000: Analyses of Sedimentary Successions. Oxford-IBH.
13. Boggs Sam Jr., 1995: Principles of Sedimentology and Stratigraphy, Prentice Hall.
14. Sengupta, S., 1997: Introduction to Sedimentology, Oxford-IBH.

PAPER TITLE: METAMORPHIC PETROLOGY

Course Code	RB090803T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Eight/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT I

Limits of metamorphism; Geothermal gradients; Metamorphic processes; Structures and textures of metamorphic rocks; Isograds and reaction isograds; Metamorphic fluids.

UNIT II

Concept and classification of metamorphic facies; Metamorphic facies series; Metamorphism of carbonates, pelitic, mafic, ultramafic and quartzofeldspathic rocks; Mineralogical phase rule in closed and open systems; Graphic representation of mineral assemblages (ACF, AKF and AFM projections);

UNIT III

Metasomatism; Metamorphic differentiation; Anatexis; Origin and structure of migmatites; Regional metamorphism and its relation to plate tectonics; Paired metamorphic belts; Concept of Pressure-Temperature-Time path; Introduction to ultrahigh pressure (UHP) and ultrahigh temperature (UHT) metamorphism.

UNIT IV

Petrogenesis of eclogites and Charnockite; Metamorphism in: Southern Granulite Terrain; Eastern Ghats Belt; Singhbhum Craton; Central India Tectonic Zone; Bastar Craton; Bundelkhand Craton; Darjeeling-Sikkim Himalaya.

Text and Reference Books

1. Barker, A.J.2004, Introduction to Metamorphic Textures and Microstructures, Routledge.
2. Bucher, K. and Grapes, R. 2011, Petrogenesis of Metamorphic Rocks, Springer.
3. Kretz, R. 1994, Metamorphic Crystallization, Wiley-Blackwell.
4. Mason, R. 1990, Petrology of the Metamorphic Rocks, Unwin Hyman Ltd.
5. Philpotts, A. and Ague, J. 2009, Principles of Igneous and Metamorphic Petrology, Cambridge University Press.
6. Spear, F. S. 1993, Metamorphic Phase Equilibria and Pressure–Temperature–Time Paths, Mineralogical Society of America.
7. Spry, A. 1969, Metamorphic Textures, Pergamon Press.
8. Vernon, R.H. and Clarke, G.L. 2008, Principles of Metamorphic Petrology, Cambridge University Press.
9. Walther, J.V. and Wood, B.J., 1986, Fluid-Rock Interactions during Metamorphism, (Advances in Physical Geochemistry Book 5), Springer
10. Winter, J.D. 2009, Principles of Igneous and Metamorphic Petrology, Pearson.
11. Yardley, B.W.D. 1996, An introduction to Metamorphic Petrology, Prentice Hall.

12. Yardley, B.W.D., MacKenzie, W.S. and Guilford, C. 1990, Atlas of Metamorphic Rocks and their textures, Longman Scientific & Technical.

PAPER TITLE: ECONOMIC AND MINING GEOLOGY

Course Code	RB090804T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Eight/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT I

Modern concept of ore genesis, Classification, characteristics and mode of occurrence of mineral deposits/ore bodies. Ore deposits and plate tectonics, Structural, physicochemical and stratigraphic control of ore localization. Fluid-inclusion in ores: Principles, assumptions, limitations and applications.

UNIT II

Texture paragenesis and zoning of ore and their significance, Concept of ore bearing fluids, their origin and migration, Wall rock alteration, Petrological ore association with Indian examples wherever possible; Ortho-magmatic ores of mafic-ultramafic associations- diamonds in kimberlite and REE in carbonatites, Cyprus type Cu-Zn ore silicious igneous rocks, Ores of sedimentary affiliation: Mn, Fe and non-ferrous ores.

UNIT III

Mineralogy, genesis, Indian distribution and use of ore minerals related to Copper, Lead, Zn, Gold and Magnesium. Principal methods of mining, sampling, ore dressing and beneficiation, Exploration for placer deposits, Open pit mining, Types of drilling methods

UNIT IV

Mineralogy, genesis, Indian distribution and use of ore minerals related to Iron, Manganese, Aluminum, Chromium and Tungston; Study of the following industrial mineral deposits with reference to their mode of occurrence, Indian distribution and use; Mica deposits; Asbestos deposits; Minerals used in ceramic and glass industries; Minerals used in fertilizers and cement industries; Basic concept of conservation and utilization of minerals.

Text / Reference Books:

1. Craig, J.M. & Vaughan.D.j.,1981: Ore Petrography and Minrology. John Wiley.
2. Evens. A.M., 1993: Ore Geology and Industrial Minerals.Blackwell.
3. Sawkins, E.J., 1984: Metal deposits in relation to plate tectonics. Spinger Verlag.
4. Stantion. R.L., 1972; Ore Petrology, McGraw Hill.
5. Torling, D.H., 1981: gEO
6. The Geology of ore deposits – J.M.Guilbert and C.F.Park, Jr.2007, Waveland Press, 985pp.
7. Ore Geology and Industrial Minerals – A.M. Evans,2013, john wiley and Sons, 213pp.

PAPER TITLE: PRACTICAL [LAB WORK & FIELD WORK]

Course Code	RB090805P	Credit	2+2 = 4
L+T+P	0+0+4	Course Duration	One semester
Semester	Eight/ Even	Contact hours	60 (P) Hours + 10 days field work.
Nature of the Course	Practical / Field Work		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination) [Practical Examination + Record file + Field Report]	

1. Optical Experiments and Petrographic techniques. Megascopic and microscopic study of important metamorphic rocks.
2. Study of the physical properties of ore-forming minerals in hand specimens, with special reference to their origin and distribution. Ore microscopy and study of the following metallic ores under the ore-microscope: pyrite, chalcopyrite, magnetite, hematite, chromite, pyrolusite and psilomelane; Drawing of maps showing the distribution of important metallic and industrial mineral deposits.
3. Study of Primary Sedimentary Structures, Grain size analysis, Statistical parameters and interpretation. Megascopic and Petrographic study in thin section of following: Quartz Arenites, Arkosic Arenites, Graywakes.
4. Preparation for Field work, Field procedures in Geological mapping in Igneous, Sedimentary and metamorphic terrain, Methods used in sampling of rocks, minerals and fossils

Geological Field Work

A field report and viva-voce based on 10 DAYS compulsory geological field survey / training to mines and places of geological importance (geological field work related to Geological mapping, Stratigraphy, Economic Geology, Mineral Exploration, Mining Methods, and other branch of Applied Geology), organized by the Department.

[Note: Every student shall be required to keep and maintain up-to-date record of practical work during the session, properly signed by the teachers concerned and submit it to the Head of the Department at the time of their Practical Examination.]

PAPER TITLE: RESEARCH PROJECT

Course Code	RB090806R	Credit	8
L+T+P	0+0+8	Course Duration	TWO Semester
Semester	Seven and Eight	Contact hours	
Nature of the Course	Research Project		
Assessment and Evaluation	[100]	Assessment will be based on the evaluation of Report submitted.	

During the VII AND VIII Semester, the students shall undertake a Dissertation on any topic of applied Geology. The topic of Dissertation shall be assigned to the students based on the available specialization. Students can do the dissertation work in department under the supervision of departmental faculty as well as students can go for dissertation in any research, academic and industry for the given time line and they would be allotted an internal Faculty in the Department, who would act as their Dissertation Internal Supervisor. The students shall remain in contact with their Supervisor, for day-to-day progress of the work done by them. During the course of completion of the Dissertation work, the student will be required to complete various assignments given to them by their respective Supervisor, for the purpose of evaluation. The students will be required to submit the Dissertation by the date specified to them in the VIII Semester.

[The Dissertation shall be of 100 Marks out of which, Marks will be on the basis of submitted Dissertation Work (Thesis), Presentation followed by Viva-voce Examination evaluated by panel of examiners Internal and external]

PAPER TITLE: APPLIED MICROPALAEONTOLOGY

Course Code	RB090901T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Nine/Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Micropaleontology and its significance; Modern field and laboratory techniques in the study of microfossils: methods of sampling, treatment and separation of microfossils from fossiliferous rocks, application of scanning electron microscopy and mass spectrometry; Types of environments and biotic distribution. Use of microfossils in dating, biozonation, biostratigraphic correlation; biozones and their types. Micropaleontology in petroleum exploration.

UNIT-II

Foraminifera: Living animal, habit, life cycle; dimorphism; test shape, wall composition, wall structure, lamellar character of wall in Foraminifera; Formation and arrangement of chambers and ornamentation in Foraminifera; Test apertures, perforations, pore plates and taxonomic importance in Foraminifera. Classification of Foraminifera. Applications of foraminifera.

UNIT-III

Ostracoda: Living animal, life habit, and morphology. Classification, ecology and stratigraphic distribution of Ostracoda. Use of Ostracoda in petroleum exploration; Conodonts: morphology, classification and its applications; Radiolaria and Diatoms: morphology, classification and significance. Nannofossils: Introduction, history of study and significance of various groups of nannofossils

UNIT-IV

Application of micropaleontology in hydrocarbon exploration; and their use in bathymetric measurement and paleoclimate interpretation. Use of paleontological data in stratigraphy, biostratigraphy, paleoecology, evolution, and sea level changes; Principle of palaeoenvironment, palaeoecology and paleoclimate; Principle of paleobiogeography; Management and conservation of palaeontological heritage.

Text / Reference Books:

1. Aldrige, R. J. (1985): Paleobiology of Conodonts, (Ed.), British Micropaleontological Society
2. Babin Claude, 1980: Elements of Palaeontology. John Wiley & Sons.
3. Clarkson, E. N. K. (1979 & 2002), Invertebrate Paleontology & Evolution, London Gorge Allen & Unwin.
4. Howard A. Armstrong and Martin D. Brasier (2005) MICROFOSSILS (IInd Ed.) Blackwell Publishing Ltd.
5. Kathal P. K. (2012): Applied Geological Micropaleontology, Scientific Publishers (India)
6. Saraswati Pratul Kumar, Srinivasan M. S. (2016): Micropaleontology – Principles and Applications, Springer.

Additional/Further Readings:

1. Alfred Traverse (1988): Paleopalynology, Unwin Hyman, USA.
2. Arnold (2002): Quaternary Environmental Micropaleontology (Ed. Simon K. Haslett), Oxford University Press, New York.
3. Kathal P. K., Rajiv Nigam, Abu Talib (2017): Micropaleontology and Its Applications Scientific Publishers (India).
4. Kennet, J. P. and Srinivasan, M. S. (1983): Neogene-Planktonic Foraminifera. Hutchison Ross Publ. Co., U. S. A.

PAPER TITLE: ENGINEERING GEOLOGY

Course Code	RB090902T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Nine/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Geotechnical engineering and environmental geo-technology: Introduction and scope, recent trends & developments. Engineering properties of rocks, behaviour under loads, stress & strain, elasticity (elastic constants), residual stresses, rock discontinuity and parameters (RQD, Q & RMR); Engineering properties of soils- soil profile, grading, index properties, consistency limits, influence of clay minerals, liquefaction, behaviour under loads, effective, neutral and total stresses, theories of failure.

UNIT-II

Dams and reservoirs: types and classification, investigations for the construction of dams and reservoir, spillways etc. Foundation rock and abutment problems- abatement technology, reservoir area problems, bearing strength of foundation rocks/soils and their improvement. Tunnels- types, tunnelling in hard and soft grounds, investigations for tunnel alignment, tunnel support design, tunnel linings, TBM, case studies.

UNIT-III

Bridges: Types, abutment and foundation problems across river and valley crossing, geological investigations for construction of bridges; Buildings– foundations and their selection, types of piles, foundation problems and their improvement. Aseismic designing - calculation of safety factor (seismic coefficient), earthquake resistance design, geo-radars.

UNIT-IV

Mass movements with special emphasis on landslides and rock falls. Slope stabilization and protection measures. Geological consideration for evaluation of dams and reservoir sites. Reservoir siltation. Geotechnical evaluation of tunnel alignments, Methods of tunnelling, classification of ground for tunnelling purposes, various types of support. Geotechnical consideration for transportation routes (Roads and railways) Geotechnical investigations for bridges and coastal barriers.

Text / Reference Books:

1. Beavis, F. C. (1985): Engineering Geology.
2. Bell, F. G. (1999): Geological Hazards, Routledge, London.
3. Bieniawski, Z. T. (1989): Engineering Rock Mass Classification, John Wiley.89
4. Bryant, E. (1985): Natural Hazards, Cambridge University Press.
5. Goodman, R.E. (1980): Introduction to rock mechanics.
6. Jagger, J. C. and Cook, N. G. W. (1979): Fundamental of rock Mechanics, Champman& Hall.
7. Johnson, R. B. and DeGraff, J. V. (1988): Principles of Engineering Geology, John Wiley.
8. Valdia, K. S. (1987): Environmental Geology, Tata McGraw hills, New Delhi
9. Keller, A. E. (1978): Environmental Geology (5th Edt.) Charis and Merril Pub. Co.
10. Montgometry, C. W. (2016): Environmental Geology, Mc Graw Hall Global Education Holding publishers.
11. Legget, R. F. (1983): Handbook of geology in civil engineering, McGraw Hill, New York.

PAPER TITLE: FUEL GEOLOGY

Course Code	RB090903T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Nine/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Understanding petroleum: its composition and different fractions. Discussion on the origin, nature, and migration (primary and secondary) of oil and gas. Detailed study on the transformation of organic matter into kerogen. Understanding the surface and subsurface occurrence of petroleum and gas.

UNIT-II

Introduction to source and reservoir rocks; Characteristics of reservoir rocks. Study of traps (structural, stratigraphic, and correlation); Overview of oil-bearing basins of India. Detailed study on the geology of the productive oil fields of India. Gas hydrates and its future potential in India.

UNIT-III

Definition and Origin of Coal; Coal-bearing Strata; Types of Coal. Rank and Grade of Coal; Indian and International Classifications of Coal; Proximate and Ultimate Analysis of Coal. Macroscopic Ingredients and Microscopic Constituents of Coal. Concept of Maceral and Micro-lithotypes; Preparation of Coal for Industrial Purposes. Coal Carbonization (Coke Manufacture); Coal Gasification and Coal Hydrogenation; Coal Bed Methane as a New Energy Resource.

UNIT-IV

Atomic Fuel and Energy Resources: Mode of Occurrence and Prospecting Methods; Productive Geological Horizons in India; Nuclear Power Stations and Future Prospects; Geothermal Energy: Fundamentals of Geothermal Energy; Exploration Techniques; Case Studies and Potential in India.

Text / Reference Books:

1. Barker, C. (1996) Thermal Modeling of Petroleum Generation, Elsevier Science, Netherlands.
2. Chandra, D., Singh, R.M. Singh, M.P. (2000). Textbook of Coal (Indian context), Tara Book Agency,Varanasi.
3. Holson, G.D. and Tiratso, E.N. (1985). Introduction of Petroleum Geology. Fulf Publishing, Houston, Texas
4. Hunt, J.M. (1996) Petroleum Geochemistry and Geology, 2nd Edition Freeman, San Francisco.
5. Jahn, F. Cook, M. and Graham, M. (1998) Hydrocarbon exploration and production. Elsevier.
6. North, F.K. (1985). Petroleum Geology. Allen Unwin.
7. Scott, A.C. (1987). Coal and Coal-bearing strata: Recent Advances. Blackwell Scientific Publications.
8. Selley, R.C. (1998) Elements of Petroleum Geology. Academic Press.
9. Singh, M.P. (1998). Coal and organic Petrology, Hindustan Publishing Corporation, New Delhi.
10. Stach, E., Mackowsky, M-Th., Taylor, G.H., Chandra, D., Teichumullelr, M. and Teichmuller R. (1982). Texbook of Coal petrology, GebruderBorntraeger, Stuttgart.
11. Taylor,G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., Littke, R. and Robert P. (1998). Organic Petrology. GebruderBorntraeger, Stuttgart.
12. Thomas, Larry (2002). Coal Geology, John Wiley and Sons Ltd., England.
13. Tissot, B.P. and Welte, D.H. (1984). Petroleum Formation and Occurrence. Springer – Verlag
14. Van Krevelen, D. W. (1993). Coal: Typology-Physics-Chemistry-Constitution). Elsevier Science, Netherlands.

PAPER TITLE: INDIAN STRATIGRAPHY

Course Code	RB090904T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Nine/ Odd	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Introduction to Stratigraphic Code and Nomenclature. Tectonic framework of India. Economic importance of Pre-Cambrian successions of India. Archaean Stratigraphy of the Dharwar Craton, Baster Craton, Singbhum Craton, Bundelkhand Craton, Aravalli Craton. Precambrian of Extra Peninsular region. Stratigraphy of the Mobile Belts of India.

UNIT-II

Archaean-Proterozoic boundary. Stratigraphy of the Proterozoic Sedimentary basins/Purana formations in India: Delhi-Aravalli Supergroup, Singbhum-Kolhan Group, Cuddapah-Kurnool, Kaladgi- Bhima-Badami, Pranhita-Godavari (Pakhal&Sullavai), Mahakoshal -Bijawar -Gwalior, DongarhgarhSupergroup. Marwar, Abujhmar- Indravati, Vindhyans- Chattisgarh- Singhora Supergroups.

UNIT-III

Precambrian-Cambrian boundary. Palaeozoic of Salt Range and their age. Marine Palaeozoic rocks of Tethys and Lesser Himalayas with fossils. Marine Palaeozoic rocks of Peninsular India with fossils. Permian Triassic boundary. Marine Mesozoic Formations of Tethyan and Lesser Himalayas with fossils. Marine Mesozoic rocks of Peninsula, and Andaman and Nicobar Island with fossils.

UNIT-IV

Concept of Gondwanaland. Classification, lithology, age, correlation, and fossils of Gondwana Supergroup. Cretaceous-Tertiary boundary. Stratigraphy of Rajmahal Volcanics and Deccan Traps and Intertrappeans. Palaeogene and Neogene global events, Tertiary successions in India, Neogene-Quaternary boundary, Tectonic evolution of Indo-Gangetic Plain. Quaternary Stratigraphy and dating methods.

Text & Reference Books:

1. Krishnan, M. S. (2017). Geology of India and Burma. 6th Edition. CBS Pub. & Dis.
2. Naqvi, S. M. and Rogers, J.J.W. (1987). Precambrian Geology of India. Oxford Univ. Press.
3. Pascoe, E. S. (1960). A Manual of Geology of India & Burma. Volume I & II Govt. of India Pub.
4. Pomerol, C. (1982). The Cenozoic Era? Tertiary and Quaternary. Ellis Harwood Ltd.
5. Ramakrishnan, N. &Vaidyanandan, R. (2010). Geology of India, v. I & II. Geol. Soc. Ind.
6. Kumar, R. (2020). Fundamentals of Historical Geology and Stratigraphy of India. New Age International Private Limited.
7. Wadia, D. N. (1967). Geology of India. McMillan & Co., London.
8. Weller, J. M. (1960). Stratigraphic Principles and Practice. Harper and Brothers.

PAPER TITLE: PRACTICAL [LAB WORK]

Course Code	RB090905P	Credit	4
L+T+P	0+0+4	Course Duration	One semester
Semester	Nine/ Odd	Contact hours	120 (P) Hours
Nature of the Course	Practical		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

1. Techniques of samples collection and preparation for foraminifera molecular study and Identification of representatives of different groups of MICROFOSSILS in SEM photomicrographs.
2. Ecological interpretation based on foraminiferal assemblages with special emphasis on conditions for oil formation.
3. Exercises on stratigraphic column: recognition of age and stratigraphic horizons on the basis of geological specimens, and location of important fossils and formations on the map of India. Study of stratigraphic distribution of some age-diagnostic fossil forms of Indian sedimentary sequences.
4. Some engineering geology calculation-based problems related to slope stability, strength parameters etc. Problems related to coal quality measurements.

[Note: Every student shall be required to keep and maintain up-to-date record of practical work during the session, properly signed by the teachers concerned and submit it to the Head of the Department at the time of their Practical Examination.]

PAPER TITLE: HYDROGEOLOGY

Course Code	RB091001T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Ten/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Introduction of water resources and current challenges. Controls of geology on groundwater occurrence, movement, and distribution; Classification of aquifers and aquifer systems; Mode of occurrence of groundwater in different geological formations and groundwater provinces of India. Concept of Darcy's law – validity of Darcy's law – Hydraulic conductivity, transmissivity, storage coefficient and specific capacity; Water table contour maps, specific yield, storage coefficient.

UNIT-II

Pump tests and evaluation of hydrologic properties through various methods for steady and unsteady flow. Determination of hydraulic conductivity. Groundwater level, its fluctuations and causes.
Surface and subsurface methods of groundwater exploration; Remote sensing techniques in groundwater exploration, Selection of suitable site for well construction; Type and design of wells, methods of well construction, well completion and well development.

UNIT-III

Concepts of artificial recharge methods; design of artificial recharge structures. Artificial recharge to groundwater and rainwater harvesting. Management of groundwater resources, Conjunctive use of groundwater and surface water; Concept of watershed: Watershed characteristics, importance of water resources; Technical aspects of artificial recharge structures; Groundwater legislation; government policies problem of overexploitation; ground water legislation.

UNIT-IV

Groundwater quality and environmental aspects; Chemical characteristics of groundwater in relation to various uses – domestic, industrial and irrigation; Saline water intrusion in coastal and other aquifers, the Ghyben - Herzberg concept and its preventive measures. Applications of H and O isotopes in groundwater studies and artificial recharge of groundwater.

Text / Reference Books:

1. Hiscock, K, (2005) Hydrogeology Principles and Practice, Wiley-Blackwell.
2. Todd, D.K. (1988): Ground Water Hydrology, John Wiley & Sons, New York.
3. Davies, S.N. and Dc-West, R.J.N. (1966): Hydrogeology, John Wiley & Sons, New York.
4. Ground Water and Wells (1977): UOP, Johnson, Div. St. Paul. Min. USA
5. Raghunath, H.M. (1983): Ground Water, Wiley Eastern Ltd., Calcutta
6. Driscoll, F.G. (1988): Ground Water and Wells, UOP, Johnson Div. St. Paul. Min. USA
7. Fetter, C.W., Applied Hydrogeology (3rd edition), New York, Macmillan,1994
8. Nandipati Subba Rao, Hydrogeology: Problems with Solutions - Prentice Hall India
9. Karanth, K.R., 1987: Groundwater Assessment-Development and Management-Tata McGraw Hall

PAPER TITLE: GEOPHYSICS

Course Code	RB091002T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Ten/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Introduction of Geophysics and its importance, Concept of seismic waves (body wave, surface wave), Detail information on seismic waves and their characteristics, seismology, seismic wave's role in earthquake, Seismic shadow zones (P and S waves shadow zones), Different discontinuities in the Earth's interior, P and S waves velocity variation from crust to the core, density, pressure and temperature variation within Earth's interior, Lithostatic pressure calculation at crust-mantle boundary.

UNIT-II

The basic introduction of different Geophysical exploration methods, Gravity method: Earth's gravitational field, Figure of the Earth, Concept of Geoid, the theoretical value of gravity (g), Densities of rocks; Gravity units, gravity anomaly, measurement of gravity.

UNIT-III

Principle of magnetic methods, magnetic anomaly, magnetism of the Earth and Earth's magnetic field, magnetic susceptibility, magnetism of rocks and minerals, Field instruments for magnetic measurement, Seismic method and its importance, Brief description of stress, strain and different types of elastic constants, P and S wave velocity in terms of elastic constant and density, Factors affecting seismic velocity, Elementary working principle of seismic method.

UNIT-IV

Introduction and classification of electrical methods, electrical properties of rocks and minerals, Concept of Ohm law, conductivity, resistivity, current and potential electrodes, Importance of resistivity survey. Introduction to Well Logs.

Text / Reference Books:

1. Dobrin M.B. (1988). Introduction to Geophysical Prospecting. McGraw Hill
2. Gadallah, M. and Fisher, R. (2009). Exploration Geophysics. Springer-Verlag Berlin Heidelberg.
3. Lowrie W. (1997). Fundamentals of Geophysics. Cambridge University Press
4. Robinson E.S. (1988). Basic Exploration Geophysics. John Wiley & Sons
5. Telford, G.S., Geldart, L.P. and Sheriff, R.E. (1990). Applied Geophysics. Cambridge University Press.

PAPER TITLE: CLIMATOLOGY

Course Code	RB091003T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Ten/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Introduction to Climate and Weather; Structure of earth's atmosphere and its layers: troposphere, stratosphere, mesosphere, ionosphere and exosphere; Composition of the atmosphere; Atmospheric boundary layers, lapse rate, Classification of climates – Koppen‟s and Thornthwaite‟s scheme of classification.

UNIT-II

Insolation; Solar radiation; Factors affecting distribution of insolation, latitudinal and seasonal variation of insolation latitudinal and seasonal variation of insolation, Temperature of the atmosphere, distribution of temperature, inversion of temperature, humidity, cloud formation and their types; precipitation and their types.

UNIT-III

Atmospheric pressure: Vertical and horizontal distribution - Winds and their causes of circulation - Types of planetary, Periodic and local winds. Air masses and Fronts- Atmospheric disturbances: Tropical and Temperate cyclones- Anti- cyclones - ElNino-Southern Oscillation (ENSO).

UNIT-IV

Concept of Monsoon; Indian Monsoon system: Southwest Monsoon (SW), Factors Influencing South-West Monsoon; Northeast Monsoon (NE); Western disturbances their Effects on monsoon; Recent climate change and its effect on Monsoon; Various Indian missions/programmes for weather and monsoon predication. An overview of Intergovernmental Panel on Climate Change (IPCC), their aims and objectives regarding climate change.

Text / Reference Books:

1. Willett, S. D., 2006. Tectonics, Climate, and Landscape Evolution, Geological Society of America Publication.
2. Bradley, R.S., Paleoclimatology: Reconstructing Climates of the Quaternary, Academic. Press.
3. Lal, D.S., 2003. Climatology. Sharda Pustak Bhawan.
4. C. Donald Ahrens, 2001. Essentials of Meteorology: An Invitation to the Atmosphere. Publisher: Brooks/Cole/Thomson Learning.
5. K. Siddhartha., 2018. Climatology: Atmosphere Weather Climate. Kitab Mahal Publication

PAPER TITLE: ENVIRONMENTAL AND MEDICAL GEOLOGY

Course Code	RB091004T	Credit	4
L+T+P	3+1+0	Course Duration	One semester
Semester	Ten/ Even	Contact hours	45(L) + 15(T)
Nature of the Course	Theory		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

UNIT-I

Fundamental concepts of environmental geology, its scope and necessity; natural hazards: earthquakes, volcanic activity, floods, landslides and coastal hazards. Geological characteristics of various environmental regimes. Physiography, drainage, climate, soils and natural resources of India. Environmental Impact Assessment (EIA) and Environmental Protection Law. Application of Geology for sustainable development; River pollution and Characteristics and problems.

UNIT-II

Water pollution: types of water pollution, groundwater pollution sources, pathways and mechanism, attenuation processes, case histories of natural and man-made water pollution; water logging, causes, effects and remedial measures; declining groundwater tables, subsidence and compaction of aquifers; Soil pollution- sources, causes, effects, and control measures; Air pollution: definition, terminology, sources and classification of air pollutants; effects of air pollution- acid rain, green-house effects and ozone layer depletion; Air pollution control and management.

UNIT-III

Introduction to medical geology and terminology; Minerals in medical geology; Geogenic distribution and abundance of elements; anthropogenic sources of elements; Essential and Non-essential elements with reference to human health; Major, minor and trace elements of human body; Micronutrient Deficiencies in Soils, Crops and Health of Humans.

UNIT-IV

Trace element deficiency and toxicity health effects: Arsenic, Cadmium, Lead, Mercury, Radon, Fluoride and Selenium; Health hazards associated with volcanic eruptions; carcinogenic associations with coal and fibrous minerals; geological effects on animal health; geophagy; Geospatial technology in Human Health Studies.

Text / Reference Books:

1. Bell, F. G. (1999). Geological Hazards, Routledge, London.
2. Bryant, E. (1985). Natural Hazards, Cambridge University Press.
3. KelIer, E. A. (1978). Environmental Geology, Bell and HowelI, USA.
4. Patwardhan, A.M. (1999). The Dynamic Earth System. Prentice Hall.
5. Smith, K. (1992). Environmental Hazards. Routledge, London.
6. Subramaniam, V. (2001). Textbook in Environmental Science, Narosa International.
7. Valdiya, X.S. (1987). Environmental Geology - Indian Context. Tata McGraw Hill.

PAPER TITLE: PRACTICAL [LAB WORK]

Course Code	RB091005P	Credit	4
L+T+P	0+0+4	Course Duration	One semester
Semester	Ten/ Even	Contact hours	120 (P) Hours
Nature of the Course	Practical		
Assessment and Evaluation	[25 + 75]	Internal Assessment [Internal Exam (10 marks) + Presentations/Assignments (10 marks) + Class Activities (5 Marks)] End Semester External Examination (University Examination)	

1. Exercises on Water Table Maps and groundwater flow direction estimation
2. Numerical problems on porosity, hydraulic conductivity, transmissivity, Storativity etc.
3. Plotting of Water Quality Data and Piper-plot, Wilcox plot etc.
4. Research ethics, importance of ethics in research.

[Note: Every student shall be required to keep and maintain up-to-date record of practical work during the session, properly signed by the teachers concerned and submit it to the Head of the Department at the time of their Practical Examination.]

PAPER TITLE: RESEARCH PROJECT

Course Code	RB091006R	Credit	8
L+T+P	0+0+8	Course Duration	TWO Semester
Semester	Nine and Ten	Contact hours	
Nature of the Course	Research Project		
Assessment and Evaluation	[100]	Assessment will be based on the evaluation of Report submitted.	

During the IX AND X Semester, the students shall undertake a Dissertation on any topic of applied Geology. The topic of Dissertation shall be assigned to the students based on the available specialization. Students can do the dissertation work in department under the supervision of departmental faculty as well as students can go for dissertation in any research, academic and industry for the given time line and they would be allotted an internal Faculty in the Department, who would act as their Dissertation Internal Supervisor. The students shall remain in contact with their Supervisor, for day-to-day progress of the work done by them. During the course of completion of the Dissertation work, the student will be required to complete various assignments given to them by their respective Supervisor, for the purpose of evaluation. The students will be required to submit the Dissertation by the date specified to them in the X Semester.

OR

A field report and viva-voce based on 10 DAYS Geological field survey / training to mines and places of geological importance (geological field work related to Geological mapping, Stratigraphy, Economic Geology, Mineral Exploration, Mining Methods, and other branch of Applied Geology), organized by the Department.

[The Dissertation/ FIELD TRAINING shall be of 100 Marks out of which, Marks will be on the basis of submitted Dissertation Work (Thesis)/ DETAILED FIELD REPORT, Presentation followed by Viva-voce Examination evaluated by panel of examiners Internal and external]

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