माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर
Maa Shakumbhari University, Saharanpur

Syllabus of the Subject Geology

For Four Year

Undergraduate Program

(FYUP)

As per guidelines of Common Minimum Syllabus by U.P. Government according to National Education Policy-2020 amended with

Go-2090/70-3-2024-09(01) Dated 02-09-2024

Members, Board of Studies (Geology)

S.No.	Name	Designation	College/University	Signature
1	Prof. Poonam Khare	Convener	J.V.Jain College Saharanpur	05/03/2025.
2	Prof. A.K. Biyani	External Expert	D.B.S. College, Dehradun	
3	Prof. R. Krishnamurti	External Expert	I.I.T. Roorkee	

Semester-wise Titles of the papers in B.Sc. Geology

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	B090101T	Physical and Structural Geology	Theory	4
1	I	B090102P	Practical: Structural Geology	Practical	2
1	II	B090201T	Mineralogy and Crystallography	Theory	4
1	II	B090202P	Practical: Mineralogy and Crystallography	Practical	2
2	III	B090301T	Palaeontology	Theory	4
2	III	B090302P	Practical: Palaeontology	Practical	2
2	IV	B090401T	Petrology	Theory	4
2	IV	B090402P	Practical: Petrology	Practical	2
3	V	B090501T	Applied Geology and Global Tectonics	Theory	4
3	V	B090502T	Stratigraphy	Theory	4
3	V	B090503R	Field Work	Field Work	2
3	VI	B090601T	Remote Sensing and Environmental Geology	Theory	4
3	VI	B090602T	Economic Geology and Groundwater	Theory	4
3	VI	B090603P	Practical: Economic Geology	Practical	2
4	VII		Mineralogy and Geochemistry	Theory	4
4	VII		Structural Geology and Tectonics	Theory	4
4	VII		Igneous Petrology	Theory	4
4	VII		Engineering Geology and Ground water	Theory	2
4	VII		Practical	Practical	4
4	VIII		Economic Geology, Mineral Exploration, Mining Methods and Mineral Economics	Theory	4
4	VIII		Metamorphic Petrology	Theory	4
4	VIII		Sedimentology	Theory	4
4	VIII		Stratigraphy	Theory	4
4	VIII		Practical	Practical	4
4	VIII		Geology Field Training	Practical	4

Program	Year/Sem	Course Code	Paper Code	Theory/ Practical	Course Title	Credit
Certifcate	I	B090101T	0120901	Compulsory	Physical and Structural Geology	4
		B090102P	0120980	Compulsory	Practical: Structural Geology	2
	II	B090201T	0220901	Compulsory	Mineralogy and Crystallography	4
		B090202P	0220980	Compulsory	Practical: Mineralogy and Crystallography	2
Diploma	III	B090301T	0320901	Compulsory	Palaeontology	4
		B090402P	0320980	Compulsory	Practical: Palaeontology	2
	IV	B090401T	0420901	Compulsory	Petrology	4
		B090402P	0420980	Compulsory	Practical: Petrology	2
Degree	V	B090501T	0520901	Compulsory	Stratigraphy	4
		B090502T	0520902	Compulsory	Applied Geology and Global tectonics	4
		B090503R	0520960	Compulsory	Field Work	2
	VI	B090601T	0620901	Compulsory	Remote Sensing and Environmental Geology	4
		B090602T	0620902	Compulsory	Economic Geology and Ground water	4
		B090603P	0620980	Compulsory	Practical: Economic Geology	2

Subject Prerequisites:

To study this subject (Geology), a student must have had the subject(s)

...**Physics/ Mathematics/ Chemistry/ Biological Sciences** .... in class/12th.

- **Programme Outcomes (POs)**

The Bachelor of Science program in the Department of Geology, J.V. Jain College, Saharanpur (Maa Shakumbhari, University, Saharanpur) is designed with the objective of educating students for success as a geo-scientist having employability in government sector, public sector, private sector, research institutes, or further qualifying JAM or other national examinations so as to pursue further study.

- **Programme Specific Outcomes (PSOs):**

Geological excursions would be important components of the B.Sc. Program in Geology for laying a robust foundation to the budding geologists. Students will get exposure to actual rocks during Geological excursion. Students will learn the data collection, measurements and interpretations.

Certificate Course in Geology	
B.sc I Programme Specific Outcomes (PSOs)	
PSO1	Physical Geology provides base for understanding of other branches of geology. Studying this will be able to learn origin of solar system and different theories of formation of earth. Internal structure of earth and understand the role of weathering agents. Structural geology will teach students how to gain an insight into underlying deformation processes. This paper helps to explore one s interest in earth sciences and geo technologies.
PSO2	Students will learn how to interpret the various type of geological maps, measure the geological data from field, interpret geological structures.
PSO3	Student should be able to learn the mineral and its types, formation of mineral groups also understand the crystal formation. This paper provides foundation needed to study other branches of geology like petrology and geochemistry
PSO4	After completing the course, student should be able to identify crystal, crystal system its symmetery, element and minerals in hand specimens as well as under polarizing microscope

Diploma Course in Geology	
B.sc II Programme Specific Outcomes(PSOs)	
PSO1	Palaeontology, the study of fossils and ancient life forms, indeed helps students to understand the evolution of life on earth. By analysing fossils and geological records student can reconstruct the historyof life, including the emergence and extinct of different species, and gain insight into the evolutionary processes that have shaped life on our planet.
PSO2	After completing the course, student will be able to Identify fossils of different phylum and their characteristics Identify Animal fossils i.e. vertebrate and invertebrate fossile Identify Plant Fossils and its distribution in different geolical time scale
PSO3	This course aims to enable the students to have broader perspective of petrology, the study of rocks. Types of rock and their mineralogical composition, texture, structure found within the rock and to understand the role of temperature and pressure in formation of rocks, sedimentation history of different sedimentary basins of India helps in understanding the process of sedimentation and rock formation. Process of metamorphism leads to the formation of metamorphic rocks
PSO4	The study of rocks in hand specimens and in thin sections will help in the identification of rocks based on mineral constituent and texture. Use of Petrological Microscope

Degree Course in Geology	
B.sc III Programme Specific Outcomes (PSOs)	
PSO1	The course is intended to familiarize the student to enable stratigraphic principles and nomenclature, major stratigraphic units, methods of stratigraphic correlation, depositional environments and tectonostratigraphic framework of various lithostratigraphic units of India
PSO2	The course aims to enable the students to have applied perspective of subject and provide the understanding of plate tectonic concepts, processes related to rifting, volcanism, earthquakes, landslide, mountain building etc. The construction of dam tunnel and safety of roads in hilly region.
PSO3	Geology is dominantly a fields based subject, visiting important geological sites will enable the students to learn the practical aspects of subject. The geological field training helps to visualize the geological cross sections, features like folds, faults, and develop an interpretative skills for geological exposure and also help to learn to collect various geological data.
PSO4	Remote sensing is a state of art-science technology, being effectively used to monitor and assess the earth resources. The students when exposed to the basics of remote sensing will be able to develop skills of interpreting the visual and digital satellite data. This along with application of GIS, will help the students in preparation of various thematic maps useful in mineral exploration, flood monitoring landuse landcover mapping. The interaction of humans with the geological environment. It will lead to have basic knowledge related to occurrence, causes, impact and mitigation of natural hazards. The role of anthopogenic activities on natural environment will be discussed.
PSO5	The objective of this course is to familiarise the students with the processes involved in the formation of various types of ore deposits. To understand the genetic controls exerted by physical and chemical processes on ore formation in various geological settings, to introduce economic and policy issues related to minerals and their national importance. To know economic how mineral is most important component for various industries. The groundwater is a life line for humans and plants. It is essential to know the relationship between rock and water and also know the key parameters affecting the quality of groundwater. Its Important to understand the methods for management, restoration and sustainable utilisation of the groundwater resources.

Detailed Syllabus –Geology
4- Year UG Degree (Honours with Research) [FYUGSM]
Or First Year of
M.Sc. 1 (GEOLOGY)

Programme/Class: **Degree**	**Year: First**	**Semesters: First**
Subject: Geology		
Course Code	**Course Title :Mineralogy and Geochemistry**	

Course outcome:

The students will be able to understand the evolution of the early Earth from proto-planetary material and its differentiation to present day state. Further this will provide the foundation for other branches of earth sciences. It will also help in gaining insight as to how geochemical processes operate within the earth. Using advanced techniques, the students will be able to better understand the atomic configuration of various mineral families.

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	Total No. of Lectures-60
I	Fundamentals of mineral chemistry: co-ordination number and bonding forces; principles of ionic substitution in minerals;partition coefficient; surface,magneticand electrical properties of minerals; twinning and crystal imperfections	
II	Repetition theory; Symmetry elements, Symmetry classes and crystal systems; Hermann- Mauguin symbols;Planelattices, Unit cell, Bravais lattices and spacegroups; Polymorphism, isomorphism, and mineraloids.	
III	X-Ray Crystallography; Bragg's Law; Single crystal diffractometry; Powder diffractometry; Silicate mineralogy; Tectosilicates; Nesosilicates, Sorosilicates, Cyclosilicates, Inosilicates, Phyllosilicates.	

IV	Mineralogy ofphosphates, carbonates, sulphides and halide groups; ClayMinerals: Properties and occurrences; Gems and semi-precious stones.	
V	Abundance of elements in earth; geochemical differentiation of the earth; goldschmidt's geochemical classification of elements; geochemical cycle; application of trace and rare earth elements in petrogenesis; stable isotope geochemistry	

Suggested Readings:

I. PutnisA.1992.Introductionto Mineral Sciences,Cambridge publication.

2. CornelisKleinandBarbaraDutrow,2007 The manualof Mineral Science,Wiley Publication

3. Mason,B.,1986.PrinciplesofGeochemistry.3rd Edition, Wiley NewYork.

4. Rollinson H. 2007 Using geochemical data-evaluation. Presentation and interpretation. 2nd Edition. Publisher Longman Scientific & amp; Technical.

5. WaltherJohn,V.,2009EssentialsofGeochemistry,studentedition.JonesandBartlett Publishers.

6. Albarede, F, 2003.An introduction to geochemistry.CambridgeUniversityPress.

PutnisA.1992.Introductionto Mineral Sciences,Cambridge publication.

7. CornelisKleinandBarbaraDutrow,2007ThemanualofMineralScience,WileyPublication

8. Mason,B.,1986.PrinciplesofGeochemistry.3rd Edition, Wiley New York.

9. Rollinson H. 2007 Using geochemical data-evaluation. Presentation and interpretation. 2nd Edition. Publisher Longman Scientific & amp; Technical.

10. WaltherJohn,V.,2009EssentialsofGeochemistry,studentedition.JonesandBartlett Publishers.

11. Albarede, F, 2003.An introductiontogeochemistry.CambridgeUniversityPress.

Programme/Class: **Degree**	**Year: First**	**Semesters: First**
Subject: Geology		
Course Code	**Course Title: Structural Geology and Tectonics**	

Course outcome:

Due to the dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid ors emi-solid state, at different scales, which manifests in a variety of complex structures in these rocks. The present course will teach the student show to gain an insight into underlying deformation processes and mechanisms through an accurate geometric and kinematic analysis of these natural structures.

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	**Topics**	**Total No. of Lectures 60**
I	Mechanical properties of rocks, Stress and its components; stress in two and three dimensions; Mohr diagrams and its significance; Strain and types of strain; Strain in two and three dimensions; Estimation of strain in naturally deformed rocks	
II	Mechanics of folding and buckling; Ramsay's classification of folds; Superposed folding, β and π diagrams.	
III	Types of tectonites; Types of rock cleavages and lineations; Time relationship between crystallisation and deformation.	
IV	Causes and dynamics of faulting; Fault geometries: normal, strike-slip and thrust, Geometry and rock types of shear zones.	
V	Structural and tectonic evolution of the Himalaya; Global Plate-tectonics – types of plate boundaries;Triple junctions; Suspect terrains; Mantle Plumes, Plume mechanism; Anatomyof mountain belts.	

Suggested Readings:

1. Bailey,B.,1992.MechanicsinStructuralGeology, Springer.
2. Davis,G.H.and Reynolds,S.J.,1996.StructuralGeologyofrocksandregions,JohnWiley. and Sons.
3. Ghosh, S.K., 1993.StructuralGeology: Fundamentals, andmoderndevelopments, Pergamon Press.
4. Leyson,P:R.and Lisle,R.J.,1996.Stereographicprojectiontechniquesinstructural geology, Cambridge University Press.
5. Passhier,C.and Trouw,R. A.J,2005. Microtectonics. Springer, Berlin.
6. Pollard, D. D. and Fletcher, R. C., 2005. Fundamentals of structural geology, CambridgeUniversity Press.
7. Ramsay,J.G.andHuber,M.I.,1983.TechniquesofModernStructuralGeology:vol.I& II. AcademicPress.
8. Ramsay, J. G, 1967. Folding and Fracturing of Rocks, McGraw-Hill Book Company, New York.
9. Rowland,S.M.,Duebendorier, E.andSchiefelbein,I.M.,2007.Structuralanalysisand synthesis: a laboratory course in structural geology, Blackwell pub.
10. Suppe,J.,1985ThePrinciplesofStructuralGeology,Prentice-Hall, Inc.,NewJersey.
11. Twiss,R.J.andMoores, E.M.,2007.StructuralGeology.Freeman.
12. VanderPluijm, B.A.andMarshak,S.,2004. Earth structure: an introduction to structural Geology.

Programme/Class: **Degree**	**Year: First**	**Semesters: First**
Subject: Geology		
Course Code:	**Course Title: Igneous Petrology**	

Course outcome

Study of igneous rocks is the primary component of any geology curriculum because these are not only the primary rocks but abundant throughout the Earth's crust. These rocks dominate upper mantle environments that provide understanding to composition of melt generation, crystallization and differentiation mechanisms, production of diverse rock types and link to tectonic settings; volcanic hazards including climatic ramification.

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Unit	**Topics**	**Total No. of Lectures 60**
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.	
II	Magma generation in the crust and mantle; mantle metasomatism; Mantle heterogeneities; Enriched and depleted mantle.	
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.	
IV	Large Igneous Provinces and mafic dyke swarms with Particular reference to Bushveld and Skaergaard complexes; Petrotectonic associations of rocks; Large Igneous Provinces through geological time.	

V	Petrogenesis of Granite, Massif Anorthosite, Kimberlite, Lamprophyre, Komatiite, Basalt, Carbonatite, Ophiolite, Andesite with suitable Indian examples.	

Suggested Readings:

1. Cox, K.G., Bell, J.D.andPankhurst, R.J.1979.Interpretationsofigneousrocks. George Allen and Unwin, London.
2. Wilson, M.1989.IgneousPetrogenesis.London Unwin Hyman.
3. AnthonyR.PhilpottsandAgue, J.J.2009.PrinciplesofIgneousandMetamorphic Petrology. Cambridge.
4. Winter, J.D.2001.Igneous andMetamorphicPetrology.PrenticeHall.
5. GautamSen, 2014.Petrology: PrinciplesandPractice: GautamSen (Springer).
6. Best,M. G. 2013.Igneous and Metamorphic Petrology. Wiley Blackwell.
7. DonL.Anderson2012 TheoryoftheEarthBlackwellScientificPublications
8. AlexanderRMcBirney,2006IgneousPetrology,IIIedition:AlexanderRMcBirney
9. White,W.M. IsotopeGeochemistry.WileyBlackwell
10. Faure,G.andMensing,T. M.2009Isotopeprinciplesand Applications.

Suggested Readings:

1. D.P.KrynineandW.R.Judd.1957.PrinciplesofEngineeringGeologyand Geotechnics, CBS publishers and distributors pvt. Ltd.
2. BhawaniSinghandR.K.Goel.1999.RockMassClassification:APracticalApproach in Civil Engineering, Elsevier Science
3. Davies, S.N.andDe-West, R.J.N., 1966.Hydrogeology, JohnWiley&Sons, New York.
4. Driscoll, F.G., 1988.GroundWaterandWells, UOP, Johnson, Div.St.Paul.Min.USA.
5. Fetter, C.W., 1984.AppliedHydrogeology, McGraw-HillBookCo.,New York.
6. Fitts, C.R., 2006.GroundwaterScience, Academic Press.
7. Freeze, R.A.andCherry,J.A.,1979.Groundwater, Englewood Cliffs,New Jersey: Prentice-Hall.
8. Karanth K.R., 1987. Groundwater: Assessment, Development and Management, Tata McGraw-Hill Pub. Co. Ltd.
9. Raghunath,H.M., 1987.GroundWater,Wiley EasternLtd., Calcutta.
10. SchwardandZhang, 2003.FundamentalsofGroundwater, JohnWilley andSons.
11. Todd,D.K., 2004.Ground WaterHydrology, JohnWiley &Sons, New York.

Paper V: Practical (Laboratorywork)

Study of the physical properties of rock forming minerals in hand specimens, with special reference to their origin and distribution. Stereographic projections and calculation of axial elements of zircon, apophyllite, beryl, calcite, barytes, orthoclase and hornblende. Study of X- ray diffractograms.

Interpretation of geological maps and sections; Structural problems using stereographic methods; □ and □ diagrams.

Study of the optical properties of rock forming minerals in thin sections. Megascopic and microscopic study of important igneous rocks. Calculation of C.I.P.W. norms and Niggli values.

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 to the Head of the Department at the time of their Practical Examination. Marks shall be assigned for these practical records

Programme/Class: **Degree**	**Year: First**	**Semesters: Second**
Subject: Geology		
Course Code:	**Course Title: Economic Geology, Mineral Exploration, Mining Methods and Mineral Economics**	

Course outcomes:

After completing the course, student should be able to the objectives of this course are to:(a)familiarize the students with the processes involved in the formation of various types of ore deposits. (b) to understand the genetic controls exerted by physical and chemical processes on ore formation in various geologic settings, and (c) to introduce economic and policy issues related to minerals and their national importance

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Unit	Topics	Total No. of Lectures-60
I	Processes of formation of ores; Magmatic deposits: Chromite deposits, Ni-Cu sulphide deposits, PGE sulfide deposits, LREE in carbonatite, REE in Pegmatite, Diamond in Kimberlite and Lamproite; Deposits formed by Sedimentary and Surficial Processes: Placer deposits, Sedimentary iron deposits, Lateritic Bauxite deposits.	
II	Hydrothermal ore deposits in magmatic and orogenic environments: Porphyry deposits, Greisen deposits, Skarn deposits, Volcanogenic Massive Sulfide(VMS) deposits, Iron oxide– copper–gold (IOCG) deposits; Hydrothermaloredepositsinsedimentaryenvironments: MississippiValley-type(MVT)Cu– Pb–Zn deposits, SEDEX Pb–Zn–Ag deposits, Stratiform Sediment-Hosted Copper Deposits, Gold deposits, Uranium Deposits.	

III	Metamorphism of ore deposits: Textures and structures of ore and gangue minerals; Concept of ore-bearing fluids; Wall rock alteration; Zoning of ore-deposits; Fluid inclusions in ore; Application of stable isotopes in ore-deposit geothermo barometry; Metallogenic epochs and mineral deposits; metallogeny and plate tectonics.	
IV	Stages of mineral exploration; Guides for Prospecting; Methods of mineral exploration: Geological, Geochemical, Geobotanical and Geophysical methods; Application of remote sensing in mineral exploration.	
V	Morphology of ore deposits; Surface and sub-surface mining; Ore-dressing; National Mineral Policy; United Nations Framework Classification (UNFC); Law of the sea; Distribution of metallic and non-metallic minerals in India.	

Suggested Readings:

1. Ridley, John.(2013).Ore deposit geology. Cambridge University Press.
2. Barnes, H.L.,1979.Geochemistry of Hydrothermal Ore Deposits, John Wiley.
3. Mookherjee,A,2000. Ore Genesis–A Holistic Approach. Allied Publisher.
4. Craig, J. R., and D.J. Vaughn. 1994. Oremicroscopy and ore mineralogy.
5. Pracejus, Bernhard.2015.Theoremineralsunderthemicroscope:anopticalguide.Vol.3. Elsevier.
6. Arndt, N.andGanino, C.2012.MetalsandSociety: AnIntroductiontoEconomic Geology. Springer.
7. Robb, L.2005.IntroductiontoOreformingProcesses. Blackwell.
8. Pohl, W.L.EconomicGeology:PrinciplesandPractice.2011.Wiley-Blackwell. Edwards, R.andAtkinson, and K.1986.OreDepositGeology: and it's in fluen ceonmineral exploration. Prasad, Umeshwar.EconomicGeology:2000.EconomicMineralDeposits.CBS publishers and distributors.
9. Bateman,A.,andJensen,M.L.1950.Economic mineral deposits. Wiley.

Programme/Class: **Degree**	**Year: First**	**Semesters: Second**
Subject: Geology		
Course Code:	**Course Title: Metamorphic Petrology**	

Course outcomes:

After completing the course, student should be able This course aims to enable the students to have broader perspective of metamorphic processes and metamorphic rocks and provide theoretical basis for interpreting the geodynamic processes. This course also seeks to help the students learn the metamorphic events that took place in different parts of India.

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	**Topics**	**Total No. of Lectures-60**
I	Limits of metamorphism; Geothermal gradients; Metamorphic processes; Structures and textures of metamorphic rocks; Isograds and reaction isograds; Metamorphic fluids.	
II	Concept and classification of metamorphic facies; Metamorphic facies series; Metamorphism of carbonates, pelitic, mafic, ultramafic and quartzofeldspathic rocks.	
III	Metasomatism; Metamorphic differentiation; Anatexis; Origin and structure of migmatites; Regional metamorphism and its relation to platetectonics; Paired metamorphic belts; Concept of Pressure-Temperature-Time path.	
IV	Mineralogical phase rule in closed and open systems; Graphic representation of mineral assemblages (ACF, AKF and AFM projections); Petrogenesis of eclogites and charnockites; Introduction to ultrahigh pressure (UHP) and ultrahigh temperature (UHT) metamorphism.	

V	Metamorphismin:SouthernGranuliteTerrain;EasternGhatsBelt;SinghbhumCraton; Central India Tectonic Zone; Bastar Craton; Bundelkhand Craton; Darjeeling-Sikkim Himalaya.	

Suggested Readings:

1. Barker, A.J.2004, IntroductiontoMetamorphicTexturesandMicrostructures, Routledge.
2. Bucher,K.and Grapes,R.2011,PetrogenesisofMetamorphicRocks,Springer.
3. Kretz, R.1994, MetamorphicCrystallization, Wiley-Blackwell.
4. Mason,R. 1990,Petrology of the Metamorphic Rocks,Unwin Hyman Ltd.
5. Philpotts, A. and Ague, J. 2009, Principles ofIgneous and Metamorphic Petrology,Cambridge University Press.
6. Spear, F.S.1993, MetamorphicPhaseEquilibriaandPressure–Temperature–Time Paths, Mineralogical Society of America.
7. Spry, A.1969, MetamorphicTextures, PergamonPress.
8. Vernon, R.H.andClarke, G.L.2008, PrinciplesofMetamorphicPetrology, 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.andGuilford, C.1990, Atlas of Metamorphic Rocks and their textures, Longman Scientific & Technical.

Programme/Class: Degree	Year: First	Semesters: Second
Subject: Geology		
Course Code:	Course Title: Sedimentology	

Course outcomes:

Sedimentary rocks are store house of many basic necessities of modern civilization viz. water,hydrocarbon etc.Major objective of the course is to make students understand fundamentals of sedimentary processes and their products, formation and filling history of sedimentary basins in different tectonic backdrop. It will lead into gaining an insight and understanding of fundamentals of fluid flow, fluid- sediment interaction and formation of bed forms at various scalesindifferentflowregimeconditions.Thestudentwillhaveaholisticunderstandingabout the texture, structure of clastic sedimentary rocks, procedure and importance of pale current analysis, concept of sedimentary environment and description of processes and products of different sedimentary environments along with the origin, mineralogy and signatures of diagentic overprinting of chemical sedimentary rocks viz. carbonate, chert, phosphorite, Evaporite etc.

Credits: 4	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	Total No. of Lectures-60
I	Earth's sedimentary shell, Weathering and sedimentary flux, Sedimentary texture: Grain size scale, statistical parameters of grain size, particle shape and fabric, Fluid flow and sediment transport, Types of fluids; Laminar vs. turbulent flow, Reynolds number, Froude Number, Particle entrainment, transport and deposition, Concept of flow regimes and bed-forms, Paleocurrent analysis.	
II	Sedimentary structures: Depositional, Erosional, Penecontemporaneous, deformational; Siliciclasticrocks: Conglomerates, sandstones, mudrocks: texture, composition, classification, origin and occurrence of sedimentary rocks.	

III	Concept of facies and facies association, Sedimentary Environments: Continental (Glacial, Fluvial,Eolian,Lacustrine),Marginalmarine:Deltaic,Estuarine,tidal,Chenier; Marine: shelf, slope, deep sea; Lithification and diagenesis of siliciclastic rocks.	
IV	Carbonate rocks: controls on carbonate deposition, Carbonate Mineralogy, Classification of limestone,Diagenesisofcarbonate:Meteoric(Vadose,Phreatic)andDeepburial,Lithification, Carbonate sedimentary environments, Ramp, Rimmed Platform and Isolated platform, Chert and siliceous sediments, Phosphorites, Evaporites	
V	Sedimentary Basins and basin analysis, Sequence stratigraphy, transgression, normal and forced regression, System tracts: high stand system tracts, low stand system tracts, transgressive system tracts, Para Sequences, Sequence boundaries, transgressive surface, maximum flooding surface.	

Suggested Readings:

1. Allen,P.A.,1997.EarthSurfaceProcesses,Blackwellpublishing.
2. Reineck, H.E. and Singh IB, 1980. Depositional Sedimentary Environments: With Reference to Terrigenous Clastics, Springer.
3. Collinson, J.D.andThompson, D.B., 1988.SedimentaryStructures, UnwinHyman, London.
4. Hsu, K.J., 2004.Physics of Sedimentology,SpringerVerlag, Berlin.
5. Leeder, M.R., 1982.Sedimentology: Process and Product. George Allen&Unwin, London, 344p.
6. Lindholm, R.C.,1987.A Practical Approach to Sedimentolog, Allen & Unwin, London.
7. Pettijohn,F.J.,1975.SedimentaryRocks,Harper and Row Publ. NewDelhi.
8. ProthoreoandSchwab,2004.SedimentaryGeology, Freeman
9. Miall,A.D.,1999.PrinciplesofSedimentaryBasinAnalysis3rdedition,Springer Verlag, New York.
10. Nichols,G.,1999.SedimentologyandStratigraphy,Blackwellpublishing.
11. SamBoggs, 1995.Principles of Sedimentology and Stratigraphy,PrenticeHall,New Jersey.
12. Tucker,M.E.,2006.SedimentaryPetrology.BlackwellPublishing.
13. James, N.PandJones,B.,2016 Originofcarbonatesedimentaryrocks. Wiley

Programme/Class: **Degree**	**Year: Fourth**	**Semester: Eight**
Subject: Geology		
Course Code:	**Course Title: Stratigraphy**	

Course outcomes:

Thecourseisintendedtofamiliarisethestudentwithstratigraphicprinciplesandnomenclature, major stratigraphic units, methods of stratigraphic correlation, depositional environments and tectono stratigraphic framework of various lithostratigraphic units of India spanning Archaean to Holocene, and mass extinction boundaries.

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	. Stratigraphy – Fundamental concepts; History of Stratigraphy; Lithostratigraphy, Biostratigraphy, Chronostratigraphy; Magnetostratigraphy; Event Startigraphy	
II	Evolution of the Indian Continental Crust; Dharwar Craton, Unmetamorphosed Proterozoic successions of India – General idea, Vindhyan Supergroup, Cuddupah Supergroup, Chhattisgarh Supergroup, Kaladgi Supergroup.	
III	Kurnool Group, Bhima Group, Marwar Supergroup, General Geology and evolution of the Himalaya,StratigraphyoftheLesserHimalayansedimentarybelts– InnerandOuter(TheKrol belt), Precambrian-Cambrian boundary	
IV	PalaeogeographyandimportanteventsofthePalaeozoicEra,MarineTriassics equences of the Himalaya with special reference to Spiti Valley,Gondwana Supergroup, Permian– Triassic boundary, Palaeogeography and important events of the Jurassic and Cretaceous periods, Jurassic successions of Western India, Cretaceous successions of Cauvery basin and Narmada valley	

V	Cretaceous-Tertiary (K–T) boundary, Palaeogene and Neogene global events, Tertiary successions in India, Neogene-Quaternary boundary, Anthropocene Epoch and Meghalayan Age	

SuggestedReadings:

1. Doyle,P.andBennett, M.R.,1996.Unlockingthe StratigraphicRecord,John Willey.
2. Dunbar,C.O.and Rodgers,J.,1957.PrinciplesofStratigraphy.JohnWiley&Sons.
3. Krishnan,M.S.,1982.Geologyof IndiaandBurma,C.B.S.Publishers,Delhi
4. Naqvi,S.M.2005.Geology and Evolution of the Indian Plate:FromHadeanto Holocene4 Ga to 4 Ka. Capital Pub., New Delhi.
5. Pascoe,E.H.,1968.AManualoftheGeologyofIndia&Burma(Vols.IN),Govt.of India Press, Delhi.
6. Pomerol,C.,1982.TheCenozoicEra-TertiaryandQuaternary.EllisHarwoodLtd., Halsted Press.
7. Schoch,R.M.,1989.Stratigraphy:PrinciplesandMethods,VanNostrandReinhold, New York. 9.
8. R.Vaidyanathan&M.Ramakrishnan,2008.Geology of India,GeologicalSocietyof India.

Paper V : Laboratory works and Vivavoce

Preparationofthinsections, OpticalExperimentsandPetrographictechniques.
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.

Study of important sedimentary rocks in hand-specimens and thin sections with emphasis on diagenetic features. Grain size determination and calculation of statistical parameters; Grain shapedetermination;Palaeo current analysis.Heavy minerals eparation and identification under microscope, and provenance interpretation; Study of stromatolites. Study of important sedimentary structures.
Megascopic and microscopic study of important metamorphic rocks.

Exercises on stratigraphic column: recognition of age and stratigraphic horizons on the basis ofgeologicalspecimens,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.

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. Marks shall be assigned for these practical records.

Paper VI: Geological Field Training

Excursion would be conducted by faculty members and if required the research students may accompanythefacultymembers.Themarkswouldbegivenbyfacultymember/sonthebasis evaluationofstudentonthebasisofActivityandperformanceinduringfieldwork, Field diary /field report and viva-voce.

*Students who want to opt 4 year UG Degree, Honors with research (and has secured 75% marks in the subject in all three years) will chose any three of the above given theory papers (4 credits each) along with research project (4 credit each) in both VII and VIII semester.

*Under the apprenticeship/ internship embedded UG degree programme the student should complete a Training Programme (1200 hrs- 40 credits) through NATS or from equivalent organization. The degree holder has to do 1 – year PG Programme. IT is purely optional for the University, to run and give this degree.