Deccan Education Society's
Fergusson College (Autonomous)
Pune - 411004

Curriculum

as per guidelines of

NEP-2020

for

M. Sc. (Geology) Part I and II

With effect from Academic Year

2023-2024

Program Structure of M.Sc. (Geology) Part-I

Semester	Paper Code	Paper Title	Credits
I	**GLY -501**	Igneous Petrology	**4**
	GLY -502	Metamorphic Petrology	**4**
	GLY -503 OR	Geomorphology, Remote Sensing and GIS	**4**
	GLY -504	Natural Resource Management	
	GLY -510	Research Methodology	**4**
	GLY -520	Geology Practical I	**2**
	GLY -521	Geology Practical II	**2**
		Total Semester Credits	**20**
II	**GLY -551**	Sedimentology	**4**
	GLY -552	Structural Geology	**4**
	GLY -553 OR	Principles of Stratigraphy and Palaeontology	**4**
	GLY -554	Environmental Geology and Disaster Management	
	GLY -560	**On Job Training**	**4**
	GLY -570	Geology Practical III	**2**
	GLY -571	Geology Practical IV	**2**
		Total Semester Credits	**20**
		Total PG-I Credits	**40**

Semester	Paper Code	Paper Title	Credits
III	**GLY -601**	Indian Stratigraphy	**4**
	GLY -602	Exploration Methods	**4**
	GLY -603 OR	Engineering Geology and Geotechniques	**4**
	GLY -604	Marine Geology	
	GLY -610	**Research Project**	**4**
	GLY -620	Geology Practical V	**2**
	GLY -621	Geology Practical VI	**2**
		Total Semester Credits	**20**
IV	**GLY -651**	Indian Mineral Deposits and Mining Geology	**4**
	GLY -652	Hydrogeology and Groundwater Development and Management	**4**
	GLY -653 OR	Petroleum Geology and Oil Field Practices	**4**
	GLY -654	Sequence Stratigraphy and Micropalaeontology	
	GLY -660	**Research Project**	**6**
	GLY -670	Geology Practical VII	**2**
		Total Semester Credits	**20**
		Total PG-II Credits	**40**

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	**15 / 30**	**1 / 2**	**25**	**10**	**15**
2	**30 / 60**	**2 / 4**	**50**	**20**	**30**
3	**45 / 90**	**3 / 6**	**75**	**30**	**45**
4	**60 / 120**	**4 / 8**	**100**	**40**	**60**

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

Program Outcomes (POs) for M. Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that form a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PO4	**Research-related skills and Scientific temper:** Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge**: Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence**: Perform independently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics**: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability**: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Program Specific Outcomes (PSOs) for M. Sc. Geology	
PSO No.	**Program Specific Outcomes (PSOs)** **Upon completion of this programme the student will be able to**
PSO1	**Academic competence** **(i)** Understand fundamental concepts, principles and processes underlying the field of Geology, its different subfields and its linkage with related disciplinary areas/subjects **(ii)** Demonstrate an understanding of a wide range of geological processes (e.g. genesis of rocks and formation of geological structures, formation of minerals and their alteration, effects of human activities at meso to microscale.) **(iii)** Undertake field tour in any part of India with respect to lithology, structure and stratigraphy and produce geological maps
PSO2	**Personal and Professional Competence** **(i)** Carry out field mapping in any part of India with respect to lithology, structure and stratigraphy and produce geological maps. **(ii)** Analyse geological data and samples procured during field work. **(iii)** Formulate ideas, execute scientific writing and authentic reporting, geological maps, effective presentation and communication skills.
PSO3	**Research Competence** **(i)** Apply skills developed towards comprehension of geological conditions to address issues and find solutions in case of ground water, mineral and fossil fuel exploration and geo hazards. **(ii)** Integrate informatics and statistical skills to explore and authenticate field and laboratory data for experimental and research purpose
PSO4	**Entrepreneurial and Social Competence:** **(i)** Employ Plan and conduct various geological services with demonstration of true values of leadership, co-operation and teamwork. **(ii)** Demonstrate awareness of ethical issues: Emphasizing on academic and research ethics, scientific misconduct, intellectual property rights and issues of plagiarism.

	M. Sc. Part- I, Semester I	
Title of the Course and Course Code	**GLY -501: Igneous Petrology**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe role of magma in geological processes	1
CO2	Discuss the physical and chemical processes that generate the range of igneous rocks	2
CO3	Classify Igneous rocks using standard classification schemes	3
CO4	Categories igneous rocks on the basis of geochemical characteristics	4
CO5	Compare various types of igneous rocks occurring in different tectonic settings	5
CO6	Compile information of different types of Igneous rocks occurring in India	6

Unit. No.	Content
Unit I	**Role of magma in Geological processes** Magma definition and source of magma, Anatomy of the earth Magmatism and plate tectonics, Physical properties of Magma-Geochemical gradient, Heat source, Igneous activity of the present day Textures and structures of Igneous rocks, Classification of Igneous rocks-historic perspective and the IUGS system.
Unit II	**Geochemical tracers of mantle processes** Introduction, Continental and oceanic mantle lithosphere MORB and depleted mantle, Evolution of depleted mantle OIB and Enriched mantle, Evolution of Enriched mantle – metasomatic processes Island arc basalts, Mantle Plumes-Theory and structure Concept of hot spots, Re-Os Isotope systematic Trace element characterizations of mantle domains
Unit III	**Magma Crystallization and Evolution** Phase relations of the silicates and silicate melts Binary and Ternary systems, Partial melting Magmatic differentiation – Crystal fractionation, gravitational Settling, flow differentiation, flow crystallisation, filter pressing, liquid immiscibility. Zone melting, Contamination, Mixing of magmas Role of volatile components
Unit VI	**Petrogenetic provinces** Continental areas: Volcanic- Flood basalts- Tholeiites (Deccan Trap, Columbia River basalts, Parana basalts) Layered gabbroic intrusions: The Bushveld complex, Skaergaard intrusion, Still water complex. Plutonic: Carbonatites and alkaline rock complexes of India Oceanic Rift valleys: MORB- Tholeiites-Ophiolites Granites, andesites, kimberlites, anorthosites.

Text / Reference Books:	1. Best Myron G., 1982, Igneous and Metamorphic Petrology, CBS Publishers and Distributors Pvt. Ltd. 2. Philpotts A,1990, Principles of Igneous and Metamorphic Petrology, Prentice Hall 3. Ray J. Sen G. Ghosh B., Topics in Igneous Petrology, 2011, Springer 4. Winter J D,2010, Principles of Igneous and Metamorphic Petrology, CBS Publishers and DistributorsPvt. Ltd, 2nd Edition 5. Wilson Marjorie,1987, Igneous Petrogenesis, Unwin Hyman.

Title of the Course and Course Code	GLY -502: Metamorphic Petrology	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe various types of metamorphism	1
CO2	Discuss the types of textures as a result of deformation	2
CO3	Examine phase diagrams to interpret and explain mineral assemblages in metamorphic rocks.	3
CO4	Compare regional and thermal metamorphism	4
CO5	Evaluate metamorphic rocks to plate tectonics	5
CO6	Critically evaluate the significance of different types of metamorphism in geological contexts.	6

Unit. No.	Content
Unit I	**Concepts and Theory** Historical background Types of Metamorphism and their controlling factors Common minerals of metamorphic rocks Field observations, petrographic classification of common metamorphic rocks Metamorphic facies and facies series
Unit II	**Effects of Metamorphism** Phase diagrams and graphic representation of mineral assemblages Prograde and retrograde metamorphism, Metasomatism Deformation textures and textures related to recrystallisation Metamorphic reactions, elemental exchange and Pressure – Temperature conditions of Isograds
Unit III	**Metamorphism types and products** Regional and thermal metamorphism of pelitic rocks. Regional and thermal metamorphism of basic rocks Regional and thermal metamorphism of impure carbonate rocks and ultrabasic rocks
Unit IV	**Metamorphism in space and time** Granitoids, Charnockites, Migmatites Plate tectonics and metamorphic processes Paired metamorphic belts, Archaean and Proterozoic terrains Extraterrestrial Metamorphism (Impact and Shock Metamorphism) polymetamorphism
Text / Reference Books:	1. Best Myron G., 1982, Igneous and Metamorphic Petrology, CBS Publishers and DistributorsPvt. Ltd. 2. Miyashiro A., 1994, Metamorphism and Metamorphic Belts, Springer 3. Winter J D, 2010, Principles of Igneous and Metamorphic Petrology, CBS Publishers andDistributors Pvt. Ltd, 2nd Edition 4. Yardley B.W.D.,1989, An Introduction to Metamorphic Petrology, Longman Scientific andTechnical

Title of the Course and Course Code	GLY -503: Geomorphology, Remote sensing and GIS	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe geomorphic features and zones in India	1
CO2	Discuss historical perspective and development of geomorphological concepts.	2
CO3	Outline various geomorphic processes and resultant landforms.	3
CO4	Explain the geological applications of remote sensing data through case studies.	4
CO5	Review remote sensing data and spatial analysis in GIS	5
CO6	Integrate knowledge of remote sensing and GIS technology to propose solutions in geological studies	6

Unit. No.	Content
Unit I	**Geomorphology I** Introduction: Development, Scope, Geomorphic concepts, Types and Tools Evolution of Landforms Endogenous and Exogenous forces, Role of Lithology, Peneplanation Rejuvenation of landforms- climatic and tectonic factors Denudational processes, Weathering, erosion and transportation Weathering products and soils profiles, types, duricrusts Hillslopes-Their characteristics and development, fluvial processes on hillslopes
Unit II	**Geomorphology II** River and drainage basin: drainage pattern, network characteristics,valleys and their development, processes of river erosion, transportation and deposition Depositional and erosional landforms- Fluvial, Coastal, Glacialand Aeolian Geomorphic indicators of neotectonic movements Stream channel morphology changes, drainage modifications, fault reactivation, Uplift – subsidence pattern in coastal areas Applied Geomorphology: Application in Geohydrology, Engineering Geology and Environmental studies Geomorphology of India: Geomorphic features and zones

Unit III	**Remote Sensing** Remote Sensing – Principles and Processes Electromagnetic radiation and spectrum Interaction of EMR with the earth, Reflectance, absorption, emittance and transmittance Interaction of EMR with atmosphere, Scattering, absorption Cartography and Projection systems Remote sensing from space – Platform, Sensors and Data Products, interpretation for geological and other studies IRS – Cartosat, Resourcesat, Oceansat, SARAL, Landsat7and 8, IKONOS, Quickbrid Thermal IR remote sensing and its applications Microwave remote sensing and its applications Hyper spectral remote sensing and its applications LIDAR, ALTM, SONAR -Basic principles, Types and Platforms andtheir applications GNSS- GPS and INSS, Principle, satellites and applications Geological Applications of Remote Sensing data and case studies
Unit IV	**Geographical Information System** GIS Technology & Applications Conceptual model of Spatial information Conceptual model of Non-spatial information Relational Model, Object orientated Database Digitization, Editing, Structuring of map data Map Projections. - Classification, Projection Type Vector based spatial Analysis Raster based spatial Analysis Digital Elevation Model and Application Applications – Case studies • Exploration of Water, Minerals and Oil • Monitoring and management of Mines • Disaster management
Text / Reference Books:	1. Kale VS, Gupta A, 2005, Introduction to Geomorphology, Orient Blackswan Private Limited 2. Savindra Singh,1998, Geomorphology, CBS Publishers and Distributors Pvt. Ltd 3. Thornbury William D.,1958, Principles of Geomorphology, CBS Publishers and Distributors Pvt. Ltd 4. Gupta, R.P., 2008, Remote Sensing Geology, Springer. 5. Jensen J.R., 2014, Remote Sensing of the Environment, Pearson 6. Lillesand, T.M. and Kiefer, R.W., 1999, Remote Sensing and Image Interpretation, Sec. Ed., John Wileyand Sons, Inc. 7. Sedimentary Environments: with reference to clastics. Springer-Verlag 8. Harold Reading, 1996, Sedimentary Environments: Processes, Facies and Stratigraphy. Wiley-Blackwell 9. Anji Reddy M., Textbook of Remote Sensing and Geographical Information System, 2001, BSP BSPublication 10. Burroughts P.A., Principles of Geographical Information Systems for Land Resources Assessment, 1986,Oxford University Press Shahab Fazal, GIS Basic, 2008, New Age International)

Title of the Course and Course Code	GLY-504: Natural Resource Management	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Classify the natural resources.	1
CO2	Describe Polices and legislation concerning natural resources	2
CO3	Discuss various natural hazards and their mitigation measures	3
CO4	Explain the changes occurring due to human activities	4
CO5	Evaluate the potential impact of a certain activity on Environment	5
CO6	Synthesize solutions on complex environmental issues	6

Unit. No.	Content
Unit I	Natural Resource Management Natural resources- soil, water, minerals, Land, Floral and Faunal Resources Classification of the Natural Resources Renewable resources-with Indian scenario (solar, wind, tidal, biofuels) Energy Resources-oil, natural gas, atomic minerals Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Wetlands-classification. Conservation & Management Coastal resources & Coastal Zone Management Function and values of the resource; Supply and demand
Unit II	Environmental Impact Analysis Polices and legislation concerning natural resources Conservation & Management of natural resources: soil, water, minerals Bio resources Energy Management Sustainability; UNEP programme towards sustainable development Geospatial technology for NRM Energy Audit and Management
Unit III	Fundamental concepts of environmental geosciences, its scope and necessity. Ecology and Ecosystems Biogeochemical cycles Geological hazards Coastal hazards Water pollution and other Issues; Case histories Groundwater pollution source
Unit IV	Soil pollution Sand Mining, Solid Waste Management, Eutrophication, Wastewater treatment Global climate change, United Nations Framework Classification Anthropogenic environmental impacts Ecotourism and other environmental services

Text / Reference Books:	1) *Shenk T.M. and A.M.Franklin*: 2001, Modeling in Natural Resource Management Development, Interpretation and Application, Island Press. 2) *Wondolleck J.M. and S.L. Yaffee*: 2000, Making Collaboration Work Lessons from Innovation in Natural Resource Management, Island Press. 3) *Paine D.P.*: 1981, Aerial Photography and Image Interpretation for Resource Management, John Wiley and Sons, New York, 571 p. 4) *Richason B.F.,Jr.*: ed. 1978, Introduction to Remote Sensing of the Environment, Kendall/ Hunt Publishing Company, Dubuque, Iowa, 496 p.

Title of the Course and Course Code	**GLY-510: Research Methodology**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Learn the various aspects of the research process, framing useful research questions, research design, data collection, analysis, writing and presentation	1
CO2	Understand the research problem, methods/techniques to be adopted	2
CO3	Apply statistical tools for analysing the data while performing their research	3
CO4	Develop skills in qualitative and quantitative data analysis and presentation	4
CO5	Analyse for fitting, errors in the measurements and able to withdraw conclusions from the analysed data	5
CO6	Execute a quality research paper and patents in science and technology	6

Unit. No.	**Content**
Unit I	An Introduction to Research Methodology: Objectives, motivation, different types of research, significance, approaches, perception of research , criteria of good research, characteristics of good hypothesis, History of research, Ancient and modern Indian research methodologies.
Unit II	Research Process: Literature search and review, defining research topic, plan of work (case study based), maintaining laboratory records (case study based). Safety in Laboratories, Ethical considerations, field data collection, safety in the field.
Unit III	Research Data Analysis: Data collection methods, Statistical analyses and its significance, various software tools for statistical analysis, errors in the measurements, Recommended for Arts, languages: creating questionnaires, data analysis from answers.
Unit IV	Research Publications: Writing research paper, abstract, project report, making a presentation, writing a research proposal, and intellectual property rights, academic integrity and antiplagiarism.

Text / Reference Books:	1. 'History of the Scientific Methods' by Martin Shuttleworth, History of the Scientific Method - How Science Became Important (explorable.com) 2. 'The Statistical Analysis of Experimental Data' by John Mandel, Dover Publications (2012). 3. 'Research Methodology Methods and Techniques' by C.R. Kothari, New Age International (P) Ltd. Publishers, 2nd revised edition (2004). 4. 'Handbook of Research Methodology: A Compendium for Scholars & Researchers' by Shanti Mishra & Alok S. Educreation Publishing, (2011). 5. 'Fundamentals of Research Methodology and Statistics' by Singh Yogesh kumar, New Age International Publishers (2006). 6. 'Research Methods: The Basics' by Walliman N., Routledge Taylor and Francis Group (2010).

Title of the Course and Course Code	**GLY-520: Practical I**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Identify and describe igneous rocks in hand specimens and thin sections	1
CO2	Identify and explain various structures and textures in Igneous rocks	2
CO3	GLY 503 Describe various landforms using aerial photographs and satellite images / GLY 504 Classify the natural resources	3
CO4	GLY 503 Analyze and interpret morphometric data of basins GLY 504 discuss various cases regarding natural resource management	4
CO5	Evaluate classification schemes based on geochemical data	5
CO6	Perform characterization of flows and flow mapping in DVP	6

Unit No.	**Content**
	GLY 501 • Identification of major rock forming minerals • Study of textures under micrscope • Characterization of following rock type under microscope o Ultrabasic rocks, Basic Igneous rocks, Intermediate Igneous rocks • Characterization of following rock type under microscope • ii. Acid Igneous rocks,Alkaline Igneous rocks • CIPW normative calculations for Igneous rocks • Study of Igneous rocks in hand specimen • Use of Geochemical analysis in Igneous Petrogenesis • Flow mapping of a suitable section in Deccan Volcanic Province

	GLY 503 • Drainage analysis- Basin characteristic factor, Stream characteristic factor, Stream order analysis • Hypsometry, GAT indices and longitudinal profiling and Slope analysis • Study of landforms and interpretation of lithology and structure from aerial photograph and satellite images • Scale measurement, conversion and preparation of basemap from Image, Toposheet and DEM **OR** **GLY 504** • Assessment of Soil - Water - Energy Mineral Resources • Study of physical properties of Atomic / Radioactive Minerals • Case studies on resource management in mining, coastal restoration, groundwater management, forest resources and sea water intrusion • Case studies on wetlands conservation

Title of the Course and Course Code	**GLY-521: Practical - II**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Identify and describe metamorphic rocks in hand specimens and thin sections	1
CO2	Interpret metamorphic grade and type of metamorphism on the basis of metamorphic textures	2
CO3	Calculate and interpret mesonorms, ACF and A'KF using geochemical data	3
CO4	GLY 503 Analysis the data using GIS software. GLY 504 Categorize Soil - Water - Energy Mineral Resources	4
CO5	GLY 503 Select geoprocessing techniques for vector data. GLY 504 Evaluate the types of coal	5
CO6	GLY 503 Generate maps using various GIS techniques GLY 504 Perform Environmental Impact Analysis	6

Unit. No.	**Content**
	GLY 502 • Study of metamorphic rocks in hand specimens • Study of textures under micrscope • Study of metamorphic rocks in thin sections • Use of ACF, A'KF diagrams and calculation • Use of AFM diagrams and calculation • Calculation of mesonorms, Metamorphic mineral assemblages with respect to metamorphic facies and grades

	GLY 503 • Introduction to QGIS and ERDAS, Geo-referencing of Toposheet and Satellite Data, Image subsetting, Resolution merge • DEM generation, Unsupervised and Supervised Classification. • Preparation of vector database and maps, Corrections of errors in GIS database, • Geo processing of Vector data- clip, merge, union, intersect **OR** **GLY 504** • Introduction to the methods of Environmental Impact assessment - geological aspects • Delineation of natural resources by using remote sensing techniques • Study of physical properties of Coal • Methods of soil conservation, soil profiles, resource planning

M. Sc. Part- I, Semester II		
Title of the Course and Course Code	**GLY -551 Sedimentology**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe origin of sediments and sediment transport	1
CO2	Classify depositional systems and discuss facies	2
CO3	Classify sedimentary basins	3
CO4	Analyze depositional systems	4
CO5	Review cycles and rhythms in sedimentary sequences	5
CO6	Formulate sedimentary sequence	6

Unit. No.	Content
Unit I	**Origin of sediments and transport** Introduction: Definition of Sedimentology, Sedimentary Petrology and Applications Definition of weathering, erosion, denudation. Types and Products of weathering, Mineral stability index Origin of sediments: siliciclastics, volcaniclastics, carbonates, chemical precipitates Sediment transport by fluid motion: Fluid properties and fluid motion: a) Physical properties of fluid b) Laminar and Turbulent flow, c) Stokes law d) Reynolds and Froude numbers Modes of sediment transport Hydrodynamic factors and Bed forms a) Concept of flow regime; b) Classification and characteristics of Flow regimes; c) Bed forms characterizing different flow regimes. d) Sedimentary Structures – their Genesis and Stratigraphic Significance. Diagenesis: Processes, Types, clastic and carbonate digenesis Classification and Petrography of Sedimentary rocks Classification of terrigenous clastic sediments and sedimentaryrocks (Breccias, Conglomerates, Sandstones, argillites). Classification of Biogenic, Chemical and Volcanogenic sediments and sedimentary rocks (Carbonates, evaporates,volcanoclastics, phosphorites, carbonaceous etc.)

Unit II	**Depositional Systems and Facies** Classification of Depositional Systems Siliciclastic Depositional environments. Carbonate Depositional Systems Chemical and Other depositional systems Facies concept Concepts of accommodation, base-level transgressions and regressions,shore-line trajectories, absolute and relative sea- levels, uplift and subsidence. Concept of Walther's Law of facies succession;
Unit III	**Basin Evolution and Basin Fills** Classification of sedimentary basins based on tectonic settings Pre-,Syn-, and Post depositional basins. Basin Morphology and Depositional Environments. Tectonics of sedimentary basins in Convergent, Divergent andshear settings Basin-Fill models of Basins in Divergent settings (Continental and Oceanic rifts,passive margins) Convergent settings (deep sea trenches, forearc and backarcbasins) Pull apart basins Remnant and Foreland basins. Basin Type Transitions (polyhistory Basins)
Unit III	**Methods in Sedimentary Basin Analysis** Provenance Analysis using Clastic petrographic data Paleocurrent Analysis Facies Analysis Recognition of cycles and rhythms in sedimentary sequences Concept of Geohistory Analysis (Subsidence analysis)
Text / Reference Books:	1. Sam Boggs Jr., 2005, Principles of Sedimentology and Stratigraphy, Pearson 2. Gary Nichols, 2009, Sedimentology and Stratigraphy,Wiley-Blackwell 3. Donald R. Prothero and Fredric Schwab, 1996, Sedimentary Geology, W. H.Freeman 4. Maurice E. Tucker,1982 Sedimentary Rocks in the field: A pratical guide,Wiley-Blackwell **5.** Andrew D. Miall , 1984, Principles of Sedimentary Basin Analysis,Springer **6.** Gerhard Einsele, 1992, Sedimentary Basins: Evolution, Facies and sediment budget,Springer- Verlag

Title of the Course and Course Code	GLY 552: Structural Geology	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe behavior of rocks under stress and strain regimes	1
CO2	Explain geodynamism of Earth system	2
CO3	Carry out deformation analysis	3
CO4	Classify macro, meso and micro structures	4
CO5	Review deformation mechanism	5
CO6	Construct Mohr circle using stress-strain data.	6

Unit. No.	Content
Unit I	**Rock Deformation** Theories of rock failure; Mechanical principles, properties of rocks and their controlling factors; Concept of stress and strain: Types of stress; stress ellipsoid; strain ellipsoid, Stress-strain relationship; Strain parameters Mohr circle construction; 2 D and 3 D Progressive deformation, significance of geological structures in relation to strain, pore pressure, failure of rocks due to differential stress Coaxial and non-coaxial deformation Mechanism of rock fracturing
Unit II	**Deformation structures** Fractures and joints: classification, nomenclature, relationships and significance; Joints/fractures in relation to stresses and their geometrical relationship with folds and faults. Faults: Causes, mechanism and dynamics of faulting, strike-slip faults, normal faults, reverse faulting Shear Zones: Brittle and ductile shear zones, geometry and products of shear zones; Mylonites and cataclasites: their origin and significance. Folds; Geometric and genetic classification, Superimposed folding, structures associated and significance Unconformity and Basement Cover relationship
Unit III	**Structural Analysis** Scope of structural analysis, MACRO-MESO- MICRO. Concept of Tectonites and their types. Planar and Linear structures, classification, origin, systematic mapping in field using standard terminology, measurement and recognition of domains, eigen value. Plotting of linear and planar structures, π and β diagrams; significance in regional studies

Unit IV	**Deformation and Metamorphism** Introduction, basic principles of deformation mechanism, concept of microtectonics. Behavior of important minerals. Porphyroblasts: origin and relationship with planar structures, S_i and Se.Dilation sites- Veins, Strain Shadows, Fringes and Boudins, origin and significance. Microscopic Shear sense indicators, integrating information with MESO and MACRO. Special Techniques in microtectonics
Text / Reference Books:	1. Fossen H, 2010 – Structural Geology, Cambridge University Press, 1st edition 2. Ghosh S.K., 2014 – Structural Geology Fundamentals and Modern Concepts, Pergamon Press UK Indianedition 3. Passchier C.W. and Throuw R.A.J.,2005 – Microtectonics, Springer-Verlag, Heidelberg- 2nd edition 4. Ramsay J.G.,1967 - Folding and Fracturing of Rocks, McGraw-Hill New York, N.Y. 5. Ramsay J.G and Huber M.I., 1983- Techniques of Modern Structural Geology, Volume 1- StrainAnalysis, Academic Press **6.** Ramsay J.G and Huber M.I., 1983- Techniques of Modern Structural Geology, Volume 2- Folds andFractures, Academic Press **7.** Turner, F.J and Weiss,L.E.,1963-Structural Analysis of Metamorphic Tectonites, McGraw-Hill NewYork,N.Y.

Title of the Course and Course Code	**GLY 553: Principles of Stratigraphy and Palaeontology**	**Number of Credits : 04**
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Summarize principles of stratigraphic correlation	1
CO2	Understand surface and subsurface procedures to establish stratigraphy	2
CO3	Apply the principles of lithofacies and biofacies in stratigraphy	3
CO4	Describe methods of collection of various types of fossils.	4
CO5	Describe fossils with spatio-temporal distribution with paleoecological and paleo-enviromental relevance	5
CO6	Integrate knowledge of various stratigraphic techniques to propose comprehensive stratigraphic analyses	6

Unit. No.	**Content**
Unit I	**Principles of Stratigraphy- I** History and Development of Stratigraphy Stratigraphic procedures Surface Subsurface Concept of Lithofacies and Biofacies Stratigraphic Correlation Litho, Bio and Chronostrarigraphic Correlation

Unit II	**Principles of Stratigraphy- II** Study of standard stratigraphic code (Lithostratigraphic, Biostratigraphic and Chronostratigraphic) Magnetostratigraphy, Chemostratigraphy, Event stratigraphy, Seismic Stratigraphy, Sequence stratigraphy Cyclo stratigraphy
Unit III	**Invertebrate Palaeontology** Scope of Palaeontology and Organic evolution Techniques in Palaeontology - collection, identification and illustration – binomial nomenclature Mega fossils, Microfossils, Nanofossils, Ichnofossils Study of Invertebrate fossils – morphology, classification, evolutionary trends, geological and geographic distribution and paleoecological and paleo-enviromental study with Indian Examples Bivalves, Cephalopoda, Gastropods, Echinoids, Corals, Brachiopods
Unit IV	**Vertebrate Palaeontology and Micropalaeontology** Brief study of vertebrate life through ages. Skeletal structure and classification of Dinosaurs Evolution of mammals. Horses, Elephants, Man Introduction to Micropalaeontology Types of Microfossils Study of Microfossils–collection, separation, taxonomy, classification and significance Foraminifera, Ostracods, Pollens and Spores calcareous algae
Text / Reference Books:	1. Krumbein and Sloss, 1963, Stratigraphy and Sedimentation, Wiley, UK 2. Nichols Gary,2009,Sedimentology and Stratigraphy Wiley-Blackwell 3. Sam Boggs, Jr., 2005, Principles of Sedimentology and Stratigraphy, Merrill Publishing Company, Columbus, Ohio. 4. Brasier M.D.,1980, Microfossils, Chapman and Hall, UK 5. Clarkston E.N.K, 1998, Invertebrate Palaeontology and Evolution, Wiley, UK 6. Clobert E.H., Morales M., Mincoff E.C.,2001, Colbert's Evolution of the Vertebrates, Wiley-Liss, New York 7. Michael Benton, 2004, Vertebrate Palaeontology, 3rd Edition, Wiley-Blackwell, USA Moore Lalicker and Fischer, 2004,Invertebrate Palaeontology, CBS Publishers and Distributors Pvt. Ltd, India

Title of the Course and Course Code	GLY 554: Environmental Geology and Disaster Management	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe environmental issues	1
CO2	Understand causes of pollution and controlling measures	2
CO3	Outline remedial measures for preventing and minimizing disasters	3
CO4	Explain natural hazards and their effects	4
CO5	Review the effects of mining on environment	5
CO6	Formulate environment suitable strategies for hazards mitigation	6

Unit. No.	Content

Unit I	**INTRODUCTION TO ENVIRONMENTAL GEOLOGY AND SCOPE**
	• Fundamental concepts of environmental geoscience, its scope and necessity.
	• Definition, structure, composition and general characteristics of lithosphere, hydrosphere, atmosphere and biosphere.
	• Biogeochemical cycles of
	  • carbon,
	  • nitrogen,
	  • phosphorus and
	  • sulfur.
	ENVIRONMENTAL ISSUES
	• Water pollution and other Issues: Drinking water sources, quality criteria and standards, Characteristics of water, Types of water pollution, Groundwater pollution source, Pathways and mechanism, Attenuation process, Case histories of natural (arsenic and fluoride poisoning) and man-made water pollution.
	• Soil pollution: Soil formation, Classification and properties, Soil salinity and alkalinity, Characteristics of saline/ alkali soils, Soil amendments. Soil pollution sources, causes and effects. Soil pollution control measures.
	Wetlands and Desertification of Lands

Unit II	**NATURAL HAZARDS, ZONING, RISK ASSESSMENT AND MANAGEMENT** • Extreme events and hazards, Catastrophic geological hazards, Study of landslides, Subsidence, Floods, Droughts, Earthquake, Volcanoes, their causes, classification, assessment, prediction and prevention. Coastal hazards, cyclones, tsunamis and shoreline and sea level changes. Strategies for hazards mitigation.

Unit III	**MINING AND ENVIRONMENT** Mining and its impact on environment, Wastes from mining industry, Waste disposal methods, Acid mine drainage, Heavy metal pollution due to mining, Environmental impacts of coal utilization, Fly ash, Recycling of resources and management. Reclamation and Rehabilitation (R&R) of Mined out area
Unit IV	**Fundamentals, Types and Remedies** Concepts related to physical system and human interference; Types and genesis of atmospheric, hydrospheric, biospheric and lithospheric disasters. Remedial measures for preventing and minimizing disasters Hazard zonation maps: preparation and utilization Preparedness and Awareness Mitigation strategy: Relief measures, community health, casualty management Role of Government, Non-Governmental and media agencies, Reconstruction and Rehabilitation Awareness through print and electronic media, involving youth in field observations
Text / Reference Books:	1. Geology, environment, Society K.S.Valdiya (2004) Universities Press (India) Private Limited, Hyderabad,India 2. Coping with natural hazards: Indian context, K.S.Valdiya (2004) Orient Longman Private Limited, Hyderabad,India. 3. Engineering and general geology Parbin Singh (2003) S.K.Kataria and sons Delhi India 4. Genaral Geology V. Radhakrishnan (1996) V.V.P.Publishers, Tuticorin,India. 5. Lundgren (1986). Environment Geology, Rentice Hall Publishers, New Jersey.

Title of the Course and Course Code	GLY -560: On Job Training	Number of Credits : 04
	Guidelines for On Job Training (OJT) /Internship for Post Graduate Students under NEP2020 are to be referred on College Website	

Title of the Course and Course Code	GLY -570: Practical - III	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Describe sedimentary rocks and primary sedimentary structures.	1
CO2	Interpret the provinces using different methods.	2
CO3	Classify sedimentary rocks using grain size and shape.	3
CO4	(GLY 553)Construct range zone and litho section / (GLY 554) Identify Natural hazard zones.	4
CO5	(GLY 553) Determine paleoenviorment using microfossils / (GLY 554) Determine hydrochemistry of given soil or water samples	5
CO6	GLY 554) Specify paleogeographic distribution of the fossils based on morphology studies / (GLY 554) Comment on suitability of water samples for various purposes.	6

Unit. No.	Content
	GLY 551 • Microscopic studies of sandstone • Microscopic studies of carbonates • "Megascopic and Microscopic studies of sandstones and carbonates • Study of sedimentary structures (Primary and Secondary) and their environmental significance" • Perform sieve and Pipet analysis for heavy minerals • Study of heavy minerals under microscope • Studies Size Analysis, Calculation on Shape Analysis • Construction of lithofacies maps and Paleocurrent Analysis • Provenance Analysis (a)using sandstone compositions; (b) using heavy minerals **GLY 553** • Preparation of litho section • Preparation of litho-stratigraphic corelation maps • preparation of range zone maps • Study of Bivalves and Gastropods, Brachiopods • Study of Cephalopods and Echinoids, Corals • Micro-Palaeontology- Study of Foraminifers, Ostracods and Palynomorphs • Separation, processing, wet sieve analyses, preparation of slides of microfossils.

	OR **GLY 554** • Study of seismic and flood prone in India; • Chemical analysis of water and soil sample data and plotting chemical classification diagram; • evaluation of environmental impact of air pollution and groundwater pollution; deforestation; landslides • Hazard zonation maps: preparation and utilization

Title of the Course and Course Code	GLY -571: Practical - IV	Number of Credits : 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	**Cognitive level**
CO1	Perform structural geology problems using different techniques	1
CO2	Analyse given structural data by various techniques.	2
CO3	Solve beta and pi diagrams	3
CO4	Understand the basics of field mapping	4
CO5	Carry out geological mapping, collect samples and prepare lithosections in the field	5
CO6	Prepare a geological map and produce a report	6

Unit. No.	Content
	GLY 552 • Solve given geological map containing inclined beds, vertical dyke, vertical fault, inclined dyke, inclined fault, folded beds; and draw a section along given line • Exercises on outcrop completion • Steriographic projections Beta and Pi diagrams • Steriographic analysis of fold data-contour method • Steriographic projections Rotation of beds • Orthographic projections- Fault plane solution • Busk method • **Fieldwork- Geological mapping in suitable terrain to learn the methods of geological mapping** • Locate yourself on field, dip and strike measurements • Litholog preparation using software • Writing field report • Preparation of geological map