Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

New Education Policy 2020

Syllabus: Applied Geology

Name of the Course: M. Sc. 2 (Sem:– III &IV)

(Syllabus to be implemented from June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Sc. 2: Applied Geology

PREAMBLE:

Department of Applied Geology of Punyashlok Ahilydevi Holkar Solapur University is one of the oldest Departments in the Solapur district. The Department of Applied Geology at Punyashlok Ahilydevi Holkar Solapur University offers the Master of Geology (M.Sc.) program. This program is designed to provide deep knowledge and develop necessary skills to acquire good jobs in various Industries such as Petroleum, Geotechnical, NRSA, Groundwater consultancy, Gemology, Exploration, Mining and in Government sector. Over the past 40 years, the faculty members of department have been committed to improving curriculum, increasing experiential learning, and identifying best practices in teaching through rigorous assessment and review of our programs.

PROGRAM OBJECTIVES:

The program objectives for student's post graduating with a degree from Applied Geology are;

1. Effective use of literature for evaluation of data, hypothesis and conclusions.
2. To communicate scientific ideas and interpretations of data in writing.
3. An interdisciplinary approach for solving the geologic problems associated with earth's geological material.
4. Conducting advanced study in many areas of geology and also eliminate deficiencies in their geological education.
5. Prepare for jobs in the Geology or student may be enrolled in doctoral program.

PROGRAMME SPECIFIC OUTCOMES:

1. Students can understand effective use of scientific methods in the geological sciences. They should have thorough knowledge about the;
    a) Earth's interior, plate movement and the development of new features on the surface of the earth.
    b) Formation process and classification of rocks and mineral.
    c) Work of geological agents with the solid earth and the formation of new landforms.
    d) Sequential arrangement of the strata and establishing history of deposition.
2. Apply knowledge and techniques from allied fields, including chemistry, physics, biology, mathematics, and computing, to solve geological problems.
3. Acquiring basic skills of geological science including use of modern technology in presenting public data, hypothesis and conclusion.
4. Applying existing field and laboratory procedures to acquire original data, and using appropriate means to analyze research data.
5. Students participate in workshops/seminar/conferences on current geological issues.
6. Contributing in public issues related with geological sciences and be ready for resolution.
7. Develop and present scientific proposal, conduct original research for Master's thesis.

PAHSUS Proposed structure for Two Year PG Program (M. Sc. Applied Geology) Part 2

Level / Difficulty	SEM	Major					**Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement & Services**	Credits	Cumulative Credits
		Mandatory	Practical	Elective	Practical Elective	Minor			
4.5 100-200	III	DSC 1-5 Geophysical and Geochemical Exploration (4 credits) 2333301 DSC 1-6 Fuel Geology (4 credits) 2333302	Practical DSC 1-5 Geophysical and Geochemical Exploration (2credits) 2333304 Practical DSC 1-6 Fuel Geology (2 credits) 2333305	DSE 1-3 (4 credits) 1.Climatology 2333306 2) Oceanography 2333307 3) Advance surveying and mapping	Practical based on **DSE 1-3** (2credits) 1) 2333308 2) 2333309		RP (04)- Field Project 2333303	22	
Exit option: Award of PG Diploma in Discipline with 44 credits OR Continue with Discipline									
5.0/200	IV	DSC 1-7 Ore Geology (4 credits) 2333401 DSC 1-8 Hydrogeology (4 credits) 2333402	Practical DSC 1-8 Hydrogeology (2 credits) 2333404	DSE 1-4 (4 credits) 1) Environmental Geology & Disaster Management 2333405 2) Natural Resource Management 2333406 3) Gemology 2333407	Practical based on **DSE 1-4** (2credits) 1) 2333408 2) 2333409 3) 2333410		RP (06) – Dissertation 2333403	22	88 PG degree in discipline

Abbreviations:
OJT: On Job Training: Internship/ Apprenticeship , **FP:** Field projects, **RM**: Research Methodology , **RP**: Research Project

Paper : DSC: 1-5	Geophysical and Geochemical Exploration			
Load/week:04				
Marks External :60		Internal:40		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Introduction to prospecting and exploration: scale of prospecting; classification of prospecting methods, objectives of exploration, principles of exploration, methods and stages. Optimization of exploration: planning, choice of exploration methods, integrated exploration sequence, organization and operation during exploration. Evaluation of mineral deposit at various stages of exploration, workable standards. Prospecting criteria and guides, geological criteria, climate, stratigraphy, facies and lithological aspects, structure and geological aspects, geochemical and geophysical anomalies, geological conditions favorable for prospecting.	15 hrs	15	1
Unit2	Exploration equipment and system, exploration openings, reconnaissance bore holes drilling system, exploration by underground and bore hole workings. Factors affecting choice of system. Methods and types of sampling, choice of sampling, sample spacing, grading mineral deposits, sample error and check. Introduction to geophysical prospecting, classification and types of prospecting methods, concept and principles of gravity and magnetic surveys, anomalies, their correction, instrumentation and field data acquisition, interpretation and application to geological problems. Concept of seismic reflection and refraction methods, instrumentation and field data acquisition, preparation of travel times curves, identification of subsurface structure	15 hrs	15	1
Unit3	Types of electrical surveys, electrode configuration, field data, resistivity methods interpretations of subsurface lithology and structures by qualitative and quantative analysis. Radiometric prospecting, principles and concept, GM and scintillation counters, field data acquisition and interpretation. Subsurface Geophysical exploration: Types of Well Logging, Instruments, subsurface structural and stratigraphic correlation.	15 hrs	15	1
Unit4	Geochemistry in mineral exploration, classification of geochemical surveys, association of elements, mobility and path finder elements. Geochemical dispersion and landscape: patterns of deep seated origin, formation of productive plutons, geochemical provinces, host rock petrochemistry, ores related to productive plutons. Biogeochemical and geobotanical surveys: choice of sampling medium and their anomalies, mapping technique, merits and demerits, biogeochemical and geobotanical indicators. Data handling and statistical interpretation of data, organization and data bank, univariate and multivariate analysis, calculation of background, threshold and cut off values.	15 hrs	15	1

Reference Books:

1. Geological prospecting -- Kreiter
2. Mineral Exploration by A.W. Rose, H.E. Hawkes & J.S. Webb
3. Rock geochemistry in mineral exploration by G.J.S. Govette Elsevier
4. Analytical methods in geochemistry prospecting by FleteherW.K.Elsevier
5. Geochemical exploration methods for mineral deposits.by Beus A.A. &Grigorian S.V.
6. Introduction to geophysical prospecting by Dobrin M.B.
7. Outlines of geophysical prospecting for geologists.by Ramchander Rao. M.B. --
8. Fundamentals of Geophysics by William Lowric
9. Applied Geophysics by Telford W.M., Geldart L.P. & Sheriff R.E

Course objectives:

1. students should learn about the prospecting and exploration, classification of prospecting methods, objectives of exploration, principles of exploration, methods and stages.
2. Student should have well knowledge about Exploration equipment's and system and also know Methods and types of sampling.
3. Handling Geophysical instrument like GM and scintillation counters, and know Types of Well Logging methods.
4. Geochemistry in mineral exploration, classification of geochemical surveys and its types are world wide in use for preliminary exploration work.

Course Outcome

1. Students can familiar about different processes of mineral exploration work.
2. Understanding different geophysical instrument and its working principal
3. Understanding different geochemical method and processes.
4. Study different sampling method, well logging method and its correlation.
5. describe the variety pathfinder element and its dispersion.

Paper : DSC 1-6	Fuel Geology			
Load/week:04				
Marks External :60		Internal:40		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Role of fuels in national development, Types of fuels, Conventional and Non- Conventional energy resources. eg. Fossil fuels, Coal, Petroleum, Natural gas, Ocean Thermal energy, Wind energy, Biomass energy and Geothermal energy, Tidal energy, Solar energy and Energy from the waste. Status of Conventional and Non- Conventional energy resource in India.	15 hrs	15	1
Unit 2	Introduction to the coal as a rock; origin of coal; classification of coal on the basic of origin, sapropelic coal and humic coal, types of coal; mode of occurrences ; structure in coal seams; Distribution of coal deposits of the world and India through geological ages; physico-chemical composition of coal; proximate analysis and ultimate analysis of coal; macroscopic constitution of coal; classification of macerals; Coal preparation: coal carbonization, coal gasification, underground coal gasification (UCG), coal hydrogenation and coal combustion; Indian coal grading; Coal Bed Methane (CBM).	15 hrs	15	1
Unit 3	Introduction to Petroleum; Origin of Petroleum: Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen; coal and oil relationship; characteristic of reservoir rock: porosity, permeability; types of reservoir rocks; Migration of oil and gas; classification of traps: Structural, stratigraphic and combination traps; Cap rock: Definition and general properties; Petroleum exploration methods, sniffer survey; geological and geographical distribution of petroleum in India through ages; chemical composition of crude oil and natural gas; classification of crude oil.	15 hrs	15	1
Unit 4	Principals of radioactive elements, radioactive decay, association and distribution of atomic minerals in nature; Mode of occurrence, origin; Mineralogy and geochemistry of radioactive minerals: uranium, thorium, zirconium, beryllium; distribution of radioactive elements in igneous, sedimentary and metamorphic terrene, Principles and methods of exploration for radioactive mineral deposits; Radiometric surveys: Methods of detection and measurement of radioactivity; Geiger Muller Counters and Scintillation Counters; Gamma ray logging of bore holes; Application of radioactivity in geochronometry; Uranium and thorium exploration in India;	15 hrs	15	1

Reference Books:

1. Petroleum Geology by F..K. North
2. Petroleum formation and occurrence by Tissot and Welte
3. Petroleum asia journal, A.A.P.G. Journal
4. Handbook of Energy Technology by V.D. Hunt
5. Introduction to Petroleum geology by Hobsson and Tirtsoo.
6. Nuclear Geology by Ashwathnarayan
7. Coal Deposits by Tatsch
8. Geothermal Systems by Reach and Mufflur.

Course objectives:

At the end of this course, students will able to :

1. understand the importance of fuel in nation building.
2. conventional and non conventional energy resources,
3. Status of Conventional and Non- Conventional energy resource in India.
4. The Petroleum Geology section provides a detailed description of clastic and carbonate reservoir rocks, with the unifying theme being that reservoir location, shape and properties can be understood and predicted from knowledge of the environments in which the sediments forming the rocks were deposited, and the various processes which occur following deposition (diagenesis).
5. Origin and composition of coal, petrography and classification.
6. Use of radioactive mineral in nation building.

Course Outcome

On successful completion of this course students will be able to:

1. Learn basic principles of petroleum exploration and field development
2. Learn specific tools and processes for analysing capillary pressure data to determine fluid migration from a source rock, to a reservoir and then to a producing well; use same principles to determine seal properties of caprocks.
3. Practice using these tools and processes with hands-on exercises.
4. coal petrography and distribution in India.
5. Radioactive mineral deposit.

Paper : DSE 1-3	Climatology			
Load/week:04				
Marks External :60		Internal:40		
Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Introduction to weather and climate; scope of climatology in applied science; Origin and evolution of Atmosphere; Composition of Atmosphere; Structure of Atmosphere; earth sun relationship; solar radiation: Albedo, Terrestrial Radiation, Terrestrial heat balance, Distribution of solar radiation; Controls of Climate: Latitudinal Variations in Solar Radiation, Altitudes, Pressure and Wind Systems.	15 hrs	15	1
Unit 2	Heating and cooling of the earth atmosphere; Distribution of Temperature; Vertical distribution of temperature; Horizontal distribution of temperature; Inversion of temperature; Isanomalous temperature; laps rate of temperature.	15 hrs	15	1
Unit 3	Atmospheric pressure; Types of pressures; Variation of atmospheric pressure; Distribution of Wind and Pressure over the surface of the earth;, Effect of land and sea on the wind and pressure distribution, Atmospheric motion; wind direction and speed. Periodic local wind and regional local wind.	15 hrs	15	1
Unit 4	General Circulation of the atmosphere: Single-Cell Model and Three-Cell Model of the General Circulation; Indian monsoon, Seasonal characteristics of Indian monsoon; Indian dipole movement, Equatorial Trough and Inter Tropical Convergence Zone (ITCZ); Mid-latitudinal circulation; Polar circulation; Jet streams; El Nino-La Nino Phenomenon; Walker circulation and El- Nino Southern oscillation (ENSO); Process of Global warming; Ozone layer depletion; greenhouse gases and global warming; Impact of climate change in India	15 hrs	15	1

References:

1. Climatology, by Lal, D. S., 2011, Sharda Pustak Bhavan.
2. General climatology by Critchfield, H. J., 2009, PHI Learning, New Delhi.
3. Climatology by Savindra Singh Pravalika Publication Allahabad

Course objectives:

1. This course focuses on providing students with an understanding of the components of the climate system, climate system dynamics, and factors that lead to changes in the climate system.
2. Students are familiar with Atmosphere, green house effect and EMR and Radiations
3. Student should learn atmospheric pressure and wind and their tuypes.
4. They should also learn about atmospheric moistures.
5. Origin and evolution of planetary system, solar system and planet characteristics.

Course Outcome

From this course students understand

1. Describe and understand the origin of the solar system and Earth;
2. Understand about atmosphere.
3. Students will be able to know about the measurement, distribution of atmospheric pressure, precipitations.
4. Students familiar in planetary system and their evolution

Paper : DSE 1-3	**Oceanography**			
Load/week:04				
Marks External :60	**Internal:40**			
Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Definition, history and facts about Oceanography; Ocean Floor Topography and Terminology – Continental Shelf, Continental Slope, Continental Margin, Continental Rise, Submarine Canyons, Mid Ocean Ridges, Trenches, Abyssal Plains; Chemical properties of sea water: Constancy of its composition and factors affecting the composition, major and minor constituents, Trace elements - artificial sea water - dissolved gases in sea water, CO2 system, dissolved oxygen And oxygen profile, nutrients in the ocean, their cycles and factors influencing their distribution: Nitrogen, phosphorus, silicate, manganese.	15 hrs	15	1
Unit 2	Fundamentals of Physical Oceanography: Physical conditions in oceans, Physical properties of oceans, Physical activities in oceans, Salinity and chlorinity; temperature; thermal properties of sea water; density and stability, conductivity, viscosity, heat budget, colligative and other properties of sea water, residence time of constituents in sea water, properties of sea ice, transmission of sound, absorption of radiation.	15 hrs	15	1
Unit 3	General Characteristics of ocean currents; Ocean deposits; Coral reefs; Various theories of origin of corals; Coral Bleaching; Sea level changes; Laws of Sea and marine pollutions; Structure, composition and mechanism of the formation of oceanic crust. Ocean margins and their significance. Opening and closing of ocean gateways and their effects on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.	15 hrs	15	1
Unit 4	The global wind system; action of wind on ocean surface; Ekman's theory; Sverdrup, Stommel and Munk's theories; upwelling and sinking with special reference to the Indian ocean. Inertial currents; divergences and convergences; geostrophic motion; barotropic and baroclinic conditions; oceanic eddies, relationship between density, pressure and dynamic topography; relative and slope currents. Wind driven coastal currents; typical scales of motion in the ocean. Indogangetic delta. Origin and evolution of the Indian Ocean, structure and physiography of the Indian Ocean, bathymetry and bottom characteristics, sediment distribution on the Indian Ocean floor. Petroleum occurrences and exploration activity around the margins of the Indian Ocean.	15 hrs	15	1

References:

1. The evolving continent by Windley.
2. Plate Tectonic and crustal Evolution by Condie.
3. Marine Geology by J.Kennet
4. Aspects of Tectonics by Waldiya.
5. Oceanography - A view of the Earth by Gross, M.G., 1972, PrenticeHall.
6. Introductory Oceanography by Thurman, B.Y., 1978, Charles E. Merill Publishing Company.
7. Principles of Oceanography by S. Davis, R.A. Jr. 1972, Addison -Wesley Publishing Company.

Course objectives:

1. study of Plate tectonics; Basic concepts and types of plate margins their characters, continental slope, shelf, chemical properties of sea water
2. Students also learn Morphologic and tectonic domains of the ocean floor and Sea level processes and Sea level changes
3. understanding oceanic environment and its morphology
4. study of The global wind system, circulation and relation between ocean and atmosphere.

Course Outcome

1. Students should know the movement of earth plate margin and its causes and consequences
2. understanding Sea level processes and Sea level changes.
3. Describe Factors controlling the deposition and distribution of oceanic sediments and Ridges deltas.

Paper : DSE 1-3	**Advance Surveying and Mapping**			
Load/week:04				
Marks External :60		**Internal:40**		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Definition, objective and fundamental of surveying, plane and geodetic surveying, concept of scale, Conventional Surveying and mapping : Chain survey, Plane Table survey, Surveying with Theodolite, Representative Factor (RF), Types of Map, Plan, Ranging, Chainage, Offsetting, concept of chainage. Concept of bearing, meridian and their types, construction and use of prismatic compass	15 hrs	15	1
Unit 2	Types of bench Marks, uses of contour maps, study and use of topo-sheets. Study of Theodolite and uses, Surveying using total station – Construction, types, principle features, field equipment, method of use, introduction to various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stake out. Cartography: Map Projection, Types of Map projections (Conical, Polyconic, Cylindrical, Equal area or Lamberts cylindrical, Mercators, Zenithal, Gnomonic) Fundamentals of global positioning system; GPS segments; GPS positioning and measuring principles; GPS data errors; differential GPS; application of GPS in surveying and mapping.	15 hrs	15	1
Unit 3	Sample - Definition, field samples (rock, soil, sediment, water), sampling methods. Sample preparation-laboratory sample. Selection and screening criterion (physical, optical, biological), Preparation of specimen for different geological studies, Types of specimen. Thin Section Studies-Etching technique Staining techniques particularly for feldspars, carbonates, dolomite, paragonite and quartz Model analysis and techniques, Calibration of eyepiece micrometer, areas selection and point counting Polished Section Studies, Reflectance (specular and diffusive) and reflectance spectrometry	15 hrs	15	1
Unit 4	Principles, advantages and limitations of the following: Xray diffraction analysis; X-ray fluorescence analysis; electron probe micro analysis Atomic Absorption Spectrometer-Single and double beam (AAS) Inductively Coupled Plasma - Atomic Emission Spectrometer (ICP-AES), Mass Spectrometry. Concepts and scopes of geological survey and mapping; base map and its use; study of outcrop: lithology and structure; field equipment; field notebook and recording of information; photography and sampling; preparation of geological map; geological field report.	15 hrs	15	1

Reference Books:

1. Elementary Surveying : An Introduction to Geomatics - Charles D. Ghilani, Pearson
2. Geology in The Field - R. R. Compton, Earthspun Books
3. Global Positioning System: Concept, Technique and Application - A. Rahman and S. Fazal, New Age International
4. Surveying (Vols. 1 & 2) - B. C. Punmia, Ashok K. Jain and Arun K. Jain, Laxmi Publications
5. Field Geology - F. H. Lahee, CBS Publishers
6. Global Positioning System: Signals, Measurements and Performance - P. Misra and P. Enge, Ganga-Jamuna Press
7. Plane and Geodetic Surveying - Aylmer Johnson, CRC Press
8. Surveying (Vols. 1 & 2) - S. K. Duggal, McGraw Hill
9. Introduction to GPS: The Global Positioning System - Ahmed El-Rabbany, Artech House
10. Surveying and Levelling ---- N. N. Basak, Tata Mc-

Course Objectives:

1. Students can understand the concept and methods of surveying
2. Students can learn to use surveying equipment like theodolite and total station.
3. Students can gain knowledge of surveying practices that are used to solve real-life problems.
4. Understanding surveying techniques: Students can learn about modern surveying techniques for mapping.

Course outcome :

1. Help student to interpret plans and maps to set out works.
2. Can easily work in civil engineering project.
3. Can locate the coordinates of a given station using relevant technology

RP (04)- Field Project

Course Objectives :

Field Work: Fieldwork/visits is compulsory (amounting to 4 credits). The field visit/work will be from 10 to 15 days. During the field visit/work students visits various Institutes, Mines. Component Marks Evaluating Authority Performance of the student in the field (Punctuality, enthusiasm, and aptitude).

Course outcome:

1) Students will understand the geological concepts.
2) Field surveys helps students to identify rocks in the field, and how to make geologic maps and cross-sections.
3) Field trips can help students understand rocks in their natural environment and their natural relationship to one another
4) Field trips can help students foster a deeper appreciation and understanding of the Earth's geology.

SEMESTER IV

Paper : DSC 1-7	Ore Geology			
Load/week:04				
Marks External :60		Internal:40		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Significance of minerals in national economy. Tenor, grade and specification for minerals. India's status in mineral production Strategic, critical and essential minerals. National minerals policy. Principles and concepts of mineral. Economics, Mineral processing technology, gravity concentration method, magnetic separation, heavy mineral separation, froth flotation method, United Nations Framework of Classification of ore deposits	**15 hrs**	**15**	**1**
Unit 2	Ore bearing fluids: magma & magmatic fluids, hydrothermal fluids, meteoric waters, sea & connate water, metamorphic fluids, thermal springs & mine waters Classification of ore deposits –Lindgren and Bateman classifications. Controls of ore localization magmatic epochs and metallogenic provinces of India. Macrotexture of Ore, Paragenesis and Zoning. Fluid inclusion geothermometry, wall rock alterations and their applications. Ore microscope, polishing and mounting of ores. Physical and Optical properties of important ore minerals.	**15 hrs**	**15**	**1**
Unit 3	Processes of formation of mineral deposits: magmatic concentration, metamorphism, contact metasomatism, Hydrothermal, submarine exhalatives, volcanogenic deposits, residual. Mechanical concentration, oxidation & supergene enrichment and skarn deposits. Ores in igneous rocks, Ores deposits of metamorphic affiliations. Strata bound and stratiform ore deposits. Mineralization associated with convergent and divergent plate boundaries.	**15 hrs**	**15**	**1**
Unit 4	Overview of mineral deposits with their geology, stratigraphy & depositional environments viz : Iron, manganese, chromium, base metals, precious metals, Industrial and refractory minerals with special reference to distribution in India. Use of micro hardness tester and reflectivity, XRD studies in determinative mineralogy.	**15 hrs**	**15**	**1**

References:-

1. Economic mineral deposits, M.L. Jensen &A.M. Batman, John Wiley & Sons
2. The Geology of Ore deposits, J.M. Gulbert & C.F. Park(JR), SWH Freeman & Co.
3. Mineral processing technology, B.A.Wills, Peragamon Press.
4. Metal depositin relation of plate tectonics, F.J. Sawkins, Springer–Verlag Press.
5. Ore deposits, Evans,--
6. Ore Genesis : A Holistic Approach, Asoke Moodherjee, Allied Publishers Ltd.
7. Ore Petrography & Microscopy ,J.R. Craig & D.T. Vaughan, John Wiley & Sons.
8. Mineral Economics, R.K. Sinha,--
9. Mineral Resources of India, R.K. Sinha & Krishnaswamy , Oxford & IBH Pub. Co. Pvt. Ltd.

10. An introduction to Ore Geology, Anthony, M. Evans, Blackwell Scientific publication, 1980.
11. Ore Genesis, Ashok Mukherji, A holistic approach, Prentice Hall, Culcutta. A.K.
12. India's mineral wealth, Brown J.C.and Dey, Oxford 1936.

Course objectives

Students will have the knowledge and skills to:
1) Recognise common ore minerals in hand samples and under the microscope
2) Demonstrate familiarity with a wide range of mineral deposits, including recognising the overall geometry, zonation and alteration patterns associated with specific classes of metallic mineral deposits
3) Relate overall geometry, zonation and alteration patterns of rock associations to specific classes of metallic mineral deposits.
4) Evaluate different processes of element enrichment by fluids and melts to from ore bodies.
5) Specific knowleg=dge of Important mineral deposits of India

Course Outcome
1) Students can familiar about different processes of mineral separation.
2) identify common rock types and minerals found in and around ore deposits;
3) describe the variety of mineral deposits and how they are found and formed
4) differentiate between resources and reserves and how to estimate them.
5) understand and describe resource operations from exploration to development;

Paper : DSC 1-8	Hydrogeology			
Load/week:04				
Marks External :60		Internal: 40		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Origin of water: meteoric, juvenile, magmatic and sea waters, Hydrologic cycle: precipitation, runoff, infiltration and evapotranspiration, Hydrographs. Subsurface movement and vertical distribution of groundwater, Springs, Classification of aquifers, Concepts of drainage basin and groundwater basin. hydrological properties of rocks – specific yield, specific retention, porosity, hydraulic conductivity, transmissivity, storage coefficient, water table fluctuations – causative factors, concept of barometric and tidal efficiencies, water table contour maps, Classification of rocks with respect to their water bearing characteristics, Hydro-stratigraphic units, Groundwater provinces of India, Hydrogeology of and Zones of India, wet lands.	15 hrs	15	1
Unit 2	Theory of groundwater flow, Darey's Law and its applications, determination of permeability in laboratory and in field, Types of wells, drilling methods, construction, design, development and maintenance of wells, specific capacity and its determination. Unconfined, confined, steady, unsteady and radial flow conditions, Pumps tests – methods, data analysis and interpretation for hydrogeologic boundaries, Evaluation of aquifer parameters using Thiem, Theis, Jacob and Walton methods, Groundwater modeling – numerical and electrical models. Groundwater quality – physical and chemical properties of water, quality criteria for different uses, graphical presentation of water quality data, groundwater quality in different provinces of India – problems of arsenic and fluoride, Saline water intrusion in coastal and other aquifers and its prevention, Radioisotopes in hydrogeological studies, Groundwater contamination.	15 hrs	15	1
Unit 3	Geological – lithological and structural mapping, fracture trace analysis, Hydrogeological – lithological classification with respect of hydrologic properties, Hydraulic continuity in relation to geologic structures, Location of springs Remote sensing – hydrogeomorphic mapping of the terrain using different images of different satellite missions, lineament mapping, shallow groundwater potential zone mapping using satellite images, Surface geophysical methods – seismic, gravity, geoelectrical and magnetic, Subsurface geophysical methods – well logging for delineation of aquifers and estimation of water quality.	15 hrs	15	1
Unit 4	Groundwater problems related to foundation work, mining, canals and tunnels, Problems of over exploitation and groundwater mining. Groundwater development in urban areas and rain water harvesting, Artificial recharge methods, Groundwater problems in arid regions and remediation. Groundwater balance and methods of estimation. Groundwater legislation. Sustainability criteria and managing renewable and nonrenewable groundwater resources	15 hrs	15	1

Reference Books :

1. Davies, and De Wiest, R.J.N. (1966) Hydrogeology, John Wiley and Sons, New York.
2. Driscoll, F.G. (1988) Groundwater and Wells, UOP, Johnson Div. St. Paul. Min. USA.
3. Karanth, K. R. (1989) Hydrogeology, Tata McGraw Hill Publishers.
4. Nagabhushaniah, H.S. (2001) Groundwater in Hydrosphere (Groundwater hydrology), CBS Publ.
5. Raghunath, H.M. (1990) Groundwater, Wiley Eastern Ltd.,
6. Todd, D.K. (1995) Groundwater Hydrology, John Wiley and Sons.
7. Tolman, C.F. (1937) Groundwater, McGraw Hill, New York and London.

Course objectives:

1) Groundwater: Origin, importance, occurrences and subsurface reservoirs. Water table contour maps. Geological factors governing the occurrence of groundwater. Aquifers and their classification.
2) Physical, Chemical and Biological characters of groundwater quality; water contaminants and pollutants. salt water intrusion in coastal aquifers, remedial measures.
3) Use of Radio Isotope.
4) Watershed management. Natural and artificial recharge of ground water. PSO-9. Wetland management. Course Outcomes CO-1. Discuss hydrological cycle and its importance. CO-2. What is precipitation?
5) Engineering structures for groundwater recharge.

Course Outcome:

1) Hydrological cycle and importance. Vertical distribution of Groundwater, porosity, permeability, Sp. Yield etc.
2) What is aquifer? Describe their various types. Describe Darcy's Law
3) Describe physical and chemical characteristics of groundwater.
4) Discuss about water contaminants and pollutants.
5) Explain the role of Radio Isotopes in hydrological studies. CO-12. Explain water harvesting and watershed management.
6) Give in detail about natural and artificial recharge of groundwater

Paper : DSE 1-4	Environmental Geology & Disaster Management			
Load/week:04				
Marks External :60		Internal:40		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Fundamental concepts of Environmental Geology, Concept of ecosystem – biotic communities, food chain and Ecologic Pyramids. Biogeochemical cycles. Impact of anthropogenic activities on air, water and soil resources. Their types, sources and causes of pollutants, coastal pollution; mixing and dispersal of pollutants in estuaries and near-shore areas; coastal zone management. Controlling measures.	15 hrs	15	1
Unit 2	Waste: Source and classification of waste products. Waste disposal and recycling methods. Control and management of waste materials. Impact assessment of anthropogenic activities such as urbanization, open cast mining and quarrying, disposal of mine and radioactive wastes, fly ash, use of fertilizers. Environmental protection – legislative measures in India. Remediation measures.	15 hrs	15	1
Unit 3	Study of Natural Hazards like meteorite impact hazard, landslides, floods and drought, earthquakes, mining, volcanic eruptions: their classification, causes, assessment, prediction and controlling measures. Use of GIS and remote sensing in natural disasters management. Preparedness for relief and recovery operations	15 hrs	15	1
Unit 4	Case histories of natural disasters of India viz. Koyana earthquake, Killari earthquake, Uttar Kasi, Nepal earthquake, Jammu and Kashmir ,Uttarakhand floods, East coast cyclones, Tsunami, drought prone regions of India with special reference to Maharashtra.	15 hrs	15	1

Reference:

1) Environmental chemistry; A.K. De
2) Environmental Geology; Keller
3) Environmetal Geology; Valdiya
4) Mineral economics : Sinha and Roy.

Course objectives

The course offers an understanding on the;

1. Know the basic fundamentals of earth science as applied to the interaction between human activity and the natural environment.
2. Identify the factors contributing air, water and soil pollution. State the role of air pollution in global pollution. Explain the effects of air pollution
3. Identify various categories of solid wastes. Explain various methods of solid waste management specific to each category of waste. Explain the effects due to solid waste pollution.
4. Understand the occurrence and availability of both surface and subsurface water resources and the role of the hydrologic cycle and pollution.

Course Outcome

Upon completing this course, each student will be able to:

1. Surface and subsurface water resources hydrogeologic cycle and pollution, point, line and area sources of pollution .
2. Water quality parameters, BIS standards, organic and inorganic pollutants, heavy metal pollution
3. Impact of anthropogenic activities on the land.
4. Study of natural hazards and remedial measures. 5. To know all about the case histories of disasters

Paper : DSE 1-4	**Natural Resource Management**			
Load/week:04				
Marks External :60		**Internal:40**		

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	Definition, broad classification of natural resources. Renewable: Solar, Wind, Geothermal, Tidal, Biomass (Bio Gas), Ocean and Magneto- hydrodynamic Power. Non Renewable: Thermal Power, Hydro Energy, Nuclear Energy and Fossil fuels. Impact on Environment and their applications. Energy Production Consumption and Energy use pertain in different part of the world.	15 hrs	15	1
Unit 2	Conservation of Energy: Importance, Methods of Conservation, Measures for Promoting Energy Conservation. Mineral Resources: metals and non-metals, formation of mineral deposits, Conservation of mineral resources and their distribution in India.	15 hrs	15	1
Unit 3	Water Resources: Surface, Ground and Frozen Water, Desalination, Uses for Agriculture, Energy Generation, Domestic Consumption. Causes for Water Stress, Water Availability and its Demand. Types of dam and impacts Water Conservation Strategies in India, Rain Water Harvesting. Land & Forest Resources: Agricultural Practices in India, Exploitation of Agricultural Land. Range Land Management. Mining, Quarrying and their Impacts. Land degradation, its causes and consequences. Importance of Forestry, Forest Products, Forest-Based Industries. Forest Fire and its Control. Afforestation and Joint Forest Management, Social Forestry, Agro- Forestry.	15 hrs	15	1
Unit 4	Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Management of Common International Resources: Ocean, climate	15 hrs	15	1

Reference Books:

1) Biomas Energy and Environment: H.R. Ravindranath, Oxford University Press, New York. 1995.
2) Ecology and Environment: P.D. Shrama, Rastogi Publications, New Delhi, 2004.
3) Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
4) Vitousek, P.M. 1994, Global Change and Natural Resource Management,. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.
5) Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
6) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.
7) Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge Univ. Press.

Course outcome:

Students who learn this course will able to;

1. Describe ecological processes, including human impacts that influence ecosystems change, natural succession and the future sustainability of natural resources.
2. Characterize natural resources and be able to quantify at least one of these resources.
3. Envision desired future conditions in an area to achieve a set of natural resource-related objectives, prescribe management actions needed to achieve those objectives, and evaluate success of these actions.
4. Students will understand how to identify and sustainably manage plant diseases in various production systems.
5. Students will understand how soil fertility is determined and how plant nutrient deficiencies are identified, and means of improving soil fertility and adding nutrients for plant growth.

Paper : DSE 1-4	GEMOLOGY			
Load/week:04				
Marks External :60			Internal:40	

Unit No.	Title and content	Contact hrs	Weightage marks	credits
Unit 1	CRYSTALLOGRAPHY : Nature of crystals; Systems of crystallography; Crystalline and non-crystalline materials; Forms; Habit; Twinning. OPTICAL PROPERTIES : Colour; Transparency; Visible Spectrum; Light Reflection; Total Internal Reflection; Single and Double Refraction; Dispersion; Polarization; Refractive index and its determination by Refractometer; Reflectivity; Reflectometers. COLOUR AND CAUSES OF COLOUR : Pleochroism; Interference; Lustre; Sheen; Opalescence; Adularescence; Irridescence; Asterism; Chatoyancy.	15 hrs	15	1
Unit 2	INSTRUMENTS USED FOR GEM IDENTIFICATION : Jeweler's Lens; Microscope; Spectroscope; Dichroscope; Chelsea colour filter; Ultraviolet light and X-rays; Polariscope; Refractometer. SYNTHETICS, COMPOSITES AND IMITATION GEMSTONES AND PLASTICS : Different methods of manufacture; Characteristics; Identification.	15 hrs	15	1
Unit 3	FASHIONING OF GEMSTONES : Procedures, processes and equipment used in cutting of diamonds and other stones. Different styles of cutting. Grading gemstones for quality of cutting. TREATMENT OF GEMSTONES : Dyeing, Coating, Heat Treatment, Irradiation, Waxing, fracture filling, oiling, laser drilling, HPHT, diffusion, mass diffusion, graphitisation, composite stones, glass filling. OCCURRENCES OF GEMSTONES : Geographical origin of gemstones is an important aspect in the assessment of quality of gemstones especially Rubies, Sapphires and Emeralds.	15 hrs	15	1
Unit 4	Electrical and Magnetic properties of gemstones, conductometer. Thermal conductivity and Thermal probes. Marketing aspects : Gem & Jewellery industry an overview, analysis of prospects and problems of various sectors such as precious/semi precious, diamonds, pearls, synthetic, imitation, jewellery studded and plain gold. Export procedures and formalities.	15 hrs	15	1

Reference Books:

1. An introduction to the Rock Forming Minerals Deer, Howie and Zussman.
2. Rock Forming Minerals Deer, Howie and Zussman.(Vol.1-5)
3. A textbook of Mineralogy by Dana.
4. Optical mineralogy P.F. Keer.
5. Optical Crystallography E.E. Wahlstrom.

Course objectives

Student should familiar about the following aspects of the course;

1. The crystal and its types. Nature and habit of crystal
2. Various optical properties of crystal used for identification.
3. Fundamentals in Gem identifications, Instruments used in gem testing.
4. Fashioning in gems, treatments of gems and occurrences.

Course Outcome

At the end of the course, students should able to know;

1. Identification of minerals.
2. Observation of the internal features of various natural and synthetics gemstones with a Microscope.
3. Demonstration of instruments used for gem testing.

Research Project (RP) – Dissertation

Course objectives

Students has to do project work on allotted topics;

1. The purpose of a thesis is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study.
2. The thesis should be written at the end of the programme and offers the opportunity to delve more deeply into and synthesize knowledge acquired in previous studies.
3. The overall goal of the thesis is for the student to display the knowledge and capability required for independent work as a Master of Science in Geology.

Course Outcome

1. Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. Deeper knowledge of methods in the major subject/field of study.
3. A capability to contribute to research and development work.
4. The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.

PRACTICALS
SEMESTER I

PRACTICAL DSC 1-5: Geophysical And Geochemical Exploration		
Marks External :30		**Internal: 10**

1) Reserve calculation problems
2) Problems on structures and site selection
3) Management of resources
4) Types of reconnaissance and determinative mineralogical aspects.
5) Analysis of seismic refraction data for velocities and thickness of subsurface layers.
6) Plotting and interpretation of resistively data
7) Plotting and analysis of self-potential data
8) Simple interpretation of geophysical well logs

PRACTICAL DSC 1-6: Fuel Geology		
Marks External :30		**Internal: 10**

1) Flash point and smoke point of crude, refractive index for crude.
2) Calculation of reservoir, petroliferous basins of India.
3) Isopach maps of petroleum reserve
4) Preparation of structural contour maps
5) Preparation of carbonate concentration maps
6) Microscopic studies of coal, placer minerals
7) Preparation of geologic cross section from well data

PRACTICAL DSE 1-3 : Climatology		
Marks External :30		**Internal: 10**

1) Interpretation of daily weather report (Temperature, rainfall, humidity)
2) Wind rose diagram; Line graph; Dispersion diagram
3) Study of Planetary images and geological maps from orbital images of Terrestrial planets.
4) Study of meteorites.

PRACTICAL DSE 1-3: Oceanography		
Marks External :30		**Internal: 10**

1) Identify the sea floor samples on display.
2) On the bathymetric given contour map color the various features as indicated Shelf, Slope, Seamounts, Submarine canyon
3) Identify the islands indicated on the map.
4) Maps related to Ocean features
5) Identification of palaeotectonic regimes and delineating their characteristics.
6) Maps related to Ocean features

PRACTICAL DSE 1-3: Advance Surveying and Mapping		
Marks External :30		**Internal: 10**

1. Measurement of distance using various instruments and techniques
2. Measurement of horizontal and vertical angles using various instruments
3. Handling and use of Abney level and dumpy level
4. Handling and use of Theodolite and Total Station
5. Use of hand held GPS

PRACTICALS
SEMESTER II

PRACTICAL DSC 1-8: Hydrogeology		
Marks External :30		**Internal: 10**

1. Preparation and interpretation of Hydrogeological maps. Computation of Hydraulic Gradient.
2. Groundwater flow maps and flow net analysis, problem related to Darcy's law.
3. Calculation eh, pH, water hardness
4. Analysis of well inventory data, pump test analysis, field techniques and computation of aquifer parameters by different methods.
5. Use of well logging techniques.
6. Exercises on groundwater exploration using remote sensing techniques.
7. Water budgeting problems.

PRACTICAL DSE 1-4: Environmental Geology & Disaster Management		
Marks External :30		**Internal: 10**

1) Study of natural hazards and zones and terminology of the associated features: viz, floods, landslides, glaciers, with the help of topographic sheets, aerial photographs and LANDSAT imageries.
2) Determination of pollutants from surface and subsurface water samples.
3) Plotting the geochemical data on variation diagrams
4) Classification of coastal zones.
5) Worldwide distribution of disasters.
6) Study of case histories of natural disasters in India.

PRACTICAL DSE 1-4: Natural Resource Management		
Marks External :30		**Internal: 10**

1) Study on water budget.
2) Estimation of roof top water harvesting.
3) Study on land capability classification.
4) Determination of ecological foot print.
5) Estimation of biogas generation.
6) Preparing mineral distribution map of India.

PRACTICAL DSE 1-4 : GEMOLOGY		
Marks External :30		**Internal: 10**

1. Observation of external features (cut, colour, fractures, etc.) of a gemstones using a 10x lens;
2. Determination of specific gravity by hydrostatic weighing method and by using heavy liquids;

3. Measurement of refractive indices and birefringence tests using a gem-testing refractometer;
4. Detection of double refraction, interference figures and internal strain with the polariscope;
5. Observation of the internal features of various natural and synthetics gemstones with a microscope;
6. Use of colour filters in detecting synthetic gemstones;
7. Visual Identification of various gemstones by its crystal system and other external properties;
8. Various types of cuts and introduction to how to cut gemstones;