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VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
POST GRADUATE CENTRE, JNANASAROVARA, NANDIHALLI-583119

Department of Studies in

APPLIED GEOLOGY

REGULATION & SYLLABUS

Master of Science
(I – IV Semester)

With effect from
2024-25

Chairman - BoS
Dept of Applied Geology
VSK University PG Centre
Nandihalli, Sandur-583 119
Ballari (Dist)

DEPARTMENT OF STUDIES IN APPLIED GEOLOGY

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Post Graduate Centre, Jnanasarovara Campus,
Nandihalli-Sandur-583119

Programme: Master of Science (M.Sc.) in Applied Geology

Programme Overview:

Duration: 2 Years (4 semesters) Programme Code: 9211

M.Sc. in Applied Geology programme is framed in such a way that to impart more Knowledge in the field of Earth Science and which focuses on preparing the students for research, as well as for application of geological knowledge in a variety of field settings. The basic aim of Earth Science education is to understand the atmosphere, biosphere, hydrosphere, lithosphere in a holistic manner and the interactions among them to address some of the most urgent societal problems. Realizing this, curriculum is instituted with the following objectives:

Programme Educational Objectives (PEOs):

1. To shape skilled and qualified Geoscientist to serve the industrial, management, educational and developmental sectors of the society, worldwide and the country.
2. To contribute to the existing knowledge bank in Earth sciences with an interdisciplinary approach.
3. To bring subjects like environmental geology, disaster management, mineral dressing, water security, resource management, applications of geoinformatics in the field of Earth Sciences etc., as academic subjects into the mainstream.
4. To develop in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.

Programme Outcomes (POs):

After completion of M.Sc. Programme in Applied Geology, students can study around the globe with new ideas and approaches that not only aim at addressing Earth's origin and evolution but also play a key role in understanding the controls of climate change and allow us to prepare our society for future environmental changes.

The programme M.Sc. in Applied Geology, students are skilled to serve as a Geoscientist in industrial management, educational and developmental sectors of the society in our country and worldwide.

Preamble

The M.Sc. in Applied Geology, Master programme is being offered under Choice Based Credit System (CBCS). The CBCS enables the students to select varieties of subjects as per her / his interest and requirement. Acquiring knowledge in the related discipline is advantageous to the students. The CBCS programme is framed in such a way that to impart more Knowledge in the field of Earth Science.

M.Sc. in Applied Geology is equivalent to M.Sc. in Geology, Geoscience, and Earth science, offered by other Universities.

Context

Applied Geology is the study of the Earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. It includes the study of organisms that have inhabited our planet. An important part of applied geology is the study of how Earth's materials, structures, processes and organisms have changed over time. Applied Geology can also refer generally to the study of the solid features of any celestial body (such as the geology of the Moon or Mars).

In this context the Vijayanagara Sri Krishnadevaraya University introduce M.Sc. course in Applied Geology to reduce the disparity between the need and availability of competent professionals to cater the requirements of our nation. This programme is basically an academic programme which focuses on preparing the students for research, as well as, for application of Geological knowledge in various field settings.

Objectives

The Vijayanagara Sri Krishnadevaraya University aims to create qualified professionals to meet the increasing social needs of the hour. Hence, this curriculum is instituted with the following objectives:

1. To shape skilled and qualified Geoscientist to serve the industrial, management, educational and developmental sectors of the society, worldwide and the country.
2. To contribute to the existing knowledge bank in Earth sciences with an interdisciplinary approach.
3. To bring subjects like environmental geology, disaster management, mineral dressing, water security, resource management, applications of geoinformatics in the field of Earth Sciences etc., as academic subjects into the mainstream.
4. To develop in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.

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Course roadmap

A two-year master's degree course in Applied Geology is offered under the Department of Studies in Applied Geology following the "choice-based credit system" with an interdisciplinary approach. The curriculum comprises inputs drawn from all applied and basic aspects of geology streams and its application based study with the implication of Geoinformatics technology.

Unique characteristics

The unique characteristics of this curriculum are that each DSC, DSE and SEC paper is integrated with theoretical knowledge and practical approach. The learning is mediated through class room facilitations, digital classroom and 3D learning modalities, laboratory experiments, internship, supervised dissertations, field works, field tour, etc. Knowledge acquisition procedures are monitored through lecture, participatory and cooperative learning. The learning processes are facilitated by experienced faculty and experts drawn from various academic institutions of repute.

Career growth

In addition to the prescribed curriculum, students will be given ample opportunities to enhance their personal and professional competencies holistically through active participation in seminars, workshops, conferences, and contributions through the journal, book, and media clubs periodically. Facilities will be provided to students to undergo personal counseling, career guidance and employment opportunity.

Condition for Admission

A candidate who has passed B.Sc. degree in any stream of this university or an examination of some other university accepted by the Syndicate as equivalent there to shall be permitted to appear and qualify for the M.Sc. in Applied Geology (CBCS) Degree examinations of this university after a course of two academic years in the Department of Studies in Applied Geology, Vijayanagara Sri Krishnadevaraya University.

Evaluation

Evaluation will be done on a continuous basis during the course work through class test and internal exams. Evaluation may be done by objective type questions, short answers, essays or a combination of these, but the end semester examination is a written examination.

Examinations

There shall be four examinations in the 2 year programme, each at end of the semester. Candidates failing in any subject / subjects will be permitted to appear for subsequent semesters as per University norms.

The practical examinations will be conducted at the end of the first, second, third and fourth semester. Candidates failing in any of the practical examination / examinations will be permitted to appear for such failed practical examination / examinations at corresponding subsequent practical examinations.

Passing Minimum

A candidate has to secure a minimum of 50% mark in each course and earn a 96 credits for the award of Master's degree.

Distribution of marks

Theory – 100 marks

Internal mark* – 30 marks

End semester Exam – 70 marks

*Internal mark will be given based on two internal assessment tests (10), seminar (5), assignment (5) and attendance. The average of the marks scored from two assessment tests will be taken for assessment.

Practical – 50 marks

Final Practical exam – 30 marks

Record & Attendance – 10 marks

Periodical assessment – 10 marks

Field visit / Mine visit / Geological study tour

Field Visit: Two weeks field visit for geological mapping in between I to IV semester. Students should submit a technical field report along with neat sketches.

OR

Mine visit: 15 days mine visit / training at selected mine-sites in between I to IV semester. Students should submit mine visit / training in the form of technical report.

OR

Geological Study Tour: Ten to fifteen days, geological study tour at selected locations in between I to IV semester. Based on tour, students have to submit a technical report.

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Question paper pattern

CBCS Question Paper Pattern for PG Semester End Examination
with Effect from the AY 2024-25
Disciplines Specific Core (DSC) and Discipline Specific Elective (DSE)

Paper Code: Paper Title:
Time: 3 Hours Max. Marks: 70
Note: Answer any *FIVE* of the following questions, each question carries equal marks.

Q1.	14 Marks
Q2.	14 Marks
Q3.	14 Marks
Q4.	14 Marks
Q5.	14 Marks

Note: Question No.1 to 5, *one question from each unit* i.e. (Unit I, Unit II, ….). The Questions may be a whole or it may consists of sub questions such as a, b, c etc…

Q6. 14 Marks

Note :Question No.6, *shall be from Unit II and III,* the Question may be a whole or it may consists of sub questions such as a,b, c etc…

Q7. 14 Marks

Note: Question No.7*, shall be from Unit IV and V*,the Question may be a whole or it may consists of sub questions such as a,b, c etc…

Q8. 14 Marks

Note: Question No-8 shall be from *Unit II, Unit III , Unit IV and Unit V*. The question shall have the following sub questions and weightage. i.e a – 05 marks, b – 05 marks, c – 04 marks.

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Skill Enhancement Courses (SECs)

Paper Code: Paper Title:

Time: 1 Hours Max. Marks: 30

There shall be Theory examinations of Multiple Choice Based Questions [MCQs] with Question Paper set of A, B, C and D Series at the end of each semester for SECs for the duration of One hour (First Fifteen Minutes for the Preparation of OMR and remaining Forty-Five Minutes for Answering thirty Questions). The Answer Paper is of OMR (Optical Mark Reader) Sheet.

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Question Paper Pattern for Subjects with Tutorial

For the subjects with Tutorial component, there is no Semester-End Examination (SEE) to the component C3. The liberty of assessment of C3 is with the concerned faculty. The faculty must present innovative method of evaluation of component C3 before the respective BoS for approval and the same must be submitted to the Registrar and Registrar(Evaluation) before the commencement of the academic year.

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VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Applied Geology

Post Graduate Centre, Jnanasarovara, Nandihalli - 583119

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

I-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FIRST	DSC1	24APG1C1L	Mineralogy	30	70	100	4	-	-	4	3
	DSC2	24APG1C2L	Geoinformatics	30	70	100	4	-	-	4	3
	DSC3	24APG1C3L	Geomorphology and Structural Geology	30	70	100	4	-	-	4	3
	DSC4	24APG1C4L	Stratigraphy and Palaeontology	30	70	100	4	-	-	4	3
	SEC1	24APG1S1LP	Field Geology and Cartography	20	30	50	1	-	2	2	1
	DSCL	24APG1C1P	Mineralogy Lab	20	30	50	-	-	4	2	4
	DSCL	24APG1C2P	Geoinformatics Lab	20	30	50	-	-	4	2	4
	DSCL	24APG1C3P	Geomorphology and Structural Geology Lab	20	30	50	-	-	4	2	4
Total Marks for I Semester						**600**				**24**	

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II-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
SECOND	DSC5	24APG2C5L	Igneous Petrology	30	70	100	4	-	-	4	3
	DSC6	24APG2C6L	Metamorphic Petrology	30	70	100	4	-	-	4	3
	DSC7	24APG2C7L	Sedimentary Petrology	30	70	100	4	-	-	4	3
	DSC8	24APG2C8L	Applied Ore Geology	30	70	100	4	-	-	4	3
	SEC2	24APG2S2LP	Digital Image Processing	20	30	50	1	-	2	2	1
	DSCL	24APG2C4P	Igneous and Metamorphic Petrology Lab	20	30	50	-	-	4	2	4
	DSCL	24APG2C5P	Sedimentary Petrology Lab	20	30	50	-	-	4	2	4
	DSCL	24APG2C6P	Applied Ore Geology Lab	20	30	50	-	-	4	2	4
Total Marks for II Semester						**600**				**24**	

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III-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	24APG3C9L	Exploration Geology	30	70	100	4	-	-	4	3
	DSC10	24APG3C10L	Hydrogeology	30	70	100	4	-	-	4	3
	DSE1	24APG3E1L	A. Indian Mineral Deposits B. Experimental Mineralogy and Petrology C. Marine Geology	30	70	100	4	-	-	4	3
	DSE2	24APG3E2L	A. Ore Dressing Technology B. Watershed Management C. Energy Resources	30	70	100	4	-	-	4	3
	GEC1	24APG3G1L	A. Study of Geoscience B. Study of Geoinformatics C. Study of Rocks and Minerals	20	30	50	2	-	-	2	2
	SEC3	24APG3S3L	Research Methodology	20	30	50	2	-	-	2	2
	DSCL	24APG3C7P	Exploration Geology Lab	20	30	50	-	-	4	2	4
	DSCL	24APG3C8P	Hydrogeology Lab	20	30	50	-	-	4	2	4
Total Marks for III Semester						**600**				**24**	

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IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FOURTH	DSC11	24APG4C11L	Advanced Geoinformatics	30	70	100	4	-	-	4	3
	DSC12	24APG4C12L	Petroleum Geology	30	70	100	4	-	-	4	3
	DSE3	24APG4E3L	A. Mining Geology B. Engineering Geology C. Oil Exploration and Production	30	70	100	4	-	-	4	3
	DSE4	24APG4E4L	A. Mineral Evaluation and Management B. Groundwater Exploration C. Industrial Geology	30	70	100	4	-	-	4	3
	GEC2	24APG4G2L	A. Water Resource Management B. Remote Sensing and GIS C. Mining and Society	20	30	50	2	-	-	2	2
	DSCL	24APG4C9P	Advanced Geoinformatics Lab	20	30	50	-	-	4	2	4
	Project	24APG4C1R	Research Project Work	30	70	100	-	-	8	4	4
Total Marks for IV Semester						**600**				**24**	

DSC – Department Specific Core, DSE – Discipline Specific Elective, SEC – Skill Enhancement Course, GEC – Generic Elective Course, IA – Internal Assessment, SEE – Semester End Examination, L – Lecture, T – Tutorial, P – Practical.

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Dept Name: Applied Geology
Semester-I
DSC1: 24APG1C1L

Course Title: Mineralogy	Course code: 24APG1C1L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the Description Mineralogical investigations methods.
2. Demonstrate the Optical Mineralogy.
3. Mineral Preparation for Microscopic study.
4. Explain the Advanced Mineralogy, Descriptive Mineralogy.

DSC1: Mineralogy

Unit	Description	Hours
1	**Elements of Crystallography:** Introduction: Definition of mineral. References on crystallography and mineralogy, Concept of crystal, translational symmetry, Point symmetry, 32 point groups, crystal faces, crystallographic directions, zones, crystal forms, forms in six crystal systems, crystal habit	10
2	**Advanced Mineralogy:** The Atomic Structure of Minerals. Rock-Forming Minerals. Physical properties of minerals: Density & specific gravity, mechanical cohesion, colour and lustre, magnetism, electrical properties. Mineral Preparation for Microscopic study; Types of Preparation, Materials for Thin Section, The Mineral Slice and Cutting	10
3	**Mineral Groups:** Silicates: crystal structure and classification of silicates, Crystallization occurrence of Minerals in igneous, metamorphic and sedimentary rocks. Ortho silicates, Ring & Di silicates, Chain silicates, Sheet silicates and Framework silicates, Carbonates, Sulfates, Phosphates, Oxides, Hydroxides, Halides and Native elements. Mineral Groups: Chemical, Physical, Optical Properties of minerals	11
4	**Optical Mineralogy:** Polarizing Microscope; General Features, Parts of Microscope, Phase Microscopy and its Examination. Adjustment of Polarizing Microscope. Plane polarized and cross polarized light; Isotropic and Anisotropic minerals; Behavior of minerals in cross polarized light- Birefringence – Uniaxial minerals – Uniaxial and Biaxial Indicatrices; Optical accessories like mica, gypsum and quartz plates – Determination of Optic sign: uniaxial and biaxial minerals- Absorption of light by minerals – Scheme of pleochroism	11
5	**Mineralogical investigations methods:** X- ray diffraction- Electron Probe Micro Analysis (EPMA), Scanning Electron Microscope (SEM), Mossbauer Spectroscopy, Thermal Analysis, Gas source Mass spectrometry, Back scattered electron detectors. IR spectroscopic method and Raman Spectroscopy	10
References:		

1. Dana, (1991) Textbook of Mineralogy, Fourth Edition, William E. Ford Edward Salisbury
2. Berry Mason, L.G, (1985), Elements of Mineralogy, Reprint, W.H. Freeman &Co.
3. Paul F. Kerr (1959), Optical Mineralogy- Third Edition. McGraw-hill book company.
4. Frye Keith (May 1974): Modern Mineralogy. Prentice Hall; First Edition edition
5. Perkins, (2010) Dexter Mineralogy,3rd Edition, Prentice Hall.
6. Ravell Phillips, W.M. & Dana. T. Griffen, (2004), Optical Mineralogy-The Non-Opaque Minerals, CBS publishers & Distributors.
7. Winchell. Elements of Optical Mineralogy part I and II. John Wiley and Sons (1956)
8. W. H. Blackburn and W. H. Dennen.Principles of mineralogy. Dubuque, IA: Wm. C. Brown Publishers. 1993)
9. William D Nesse. Introduction to Optical Mineralogy. Oxford University Press, USA; 3 edition (August 21, 2003)
10. Rutley - Mineralogy. Springer; 27th edition (November 30, 1988).

Date: 06-11-2024

Course Coordinator

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Dept Name: Applied Geology
Semester-I

DSC2: 24APG1C2L

Course Title: Geoinformatics	Course code: 24APG1C2L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the basic principles of Remote Sensing
2. Categorize insight into different kinds of sensors, systems and satellite platforms
3. Formulate the relationship between electromagnetic radiation, geo objects and the generation of geo metadata information
4. Predict the basic principles of GIS and GPS.

DSC2: Geoinformatics

Unit	Description	Hours
1	**Elements of Remote Sensing:** An Introduction: History and Development of Remote Sensing, Fundamental Principles of Remote Sensing- Stages in Remote Sensing Process. Types of Remote Sensing- Advantages of Remote sensing, Aerial Photographs, Basics of Stereo models, Photo Mosaics and Photo scale. Electro Magnetic Radiation (EMR): EMR Spectrum – EMR Interaction with Atmosphere: Absorption, Scattering & Atmospheric windows	12
2	**Satellites and Sensors:** Platforms- Satellite Orbits: Geostationary, Sun synchronous Satellites - Landsat Series, SPOT Series, Indian Remote Sensing Satellites, Quick bird Satellite, World View, Geo Eye, ASTER, MODIS, NOAA	10
3	**Resolutions and Scanning:** Resolution: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Multispectral Resolution. Scanning Mechanisms: Across Track Scanning, Along Track Scanning	10
4	**Geographical Information System (GIS):** Introduction to GIS. Type of data – spatial and non spatial data – data structure – vector and raster formats – hardware for GIS — scanner – digitizer – standard GIS packages - database concepts – data input – retrieval – Assigning rank and weightage for geologic studies, overlay analysis	10
5	**Global Navigation Satellite System (GNSS):** Introduction – Satellite, Control and User Segments – Signal Components, Errors in GNSS observations, PS positioning, Differential GNSS. GNSS Mapping: Conventional Static, Kinematic GNSS Semi kinematic (Stop & Go) – Rapid static Mobile mapping	10

References:

1. D.R.Lueder. Aerial photographic interpretation, Principles and applications. McGraw-Hill New York. (1959)
2. Anji Reddy, M. (2012) Textbook of Remote Sensing & GIS, BS

Publications,Hyderabad
3. Photogeology - Miller, J.C.
4. Manual of colour aerial photography -Ed. Smith, J.T.Jr. American society of photogrammetry. 1968
5. Manual of photogrammetry - Ed: MorrieM.Thompson.
6. Manual of Remote sensing - Ed: Robert G Reeves.
7. Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern.
8. Remote sensing in Geology - Parry S. Siegal& Alan. R.Gillespie
9. Manual of photographic interpretation - Ed: Colwell, R.N.
10. Thomas M Lillesand, R W Kieffer, J W Chipmas. Remote sensing and image interpretation. John Wiley & Sons, 2009

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Dept Name: Applied Geology
Semester-I
DSC3: 24APG1C3L

Course Title: Geomorphology and Structural Geology	Course code: 24APG1C3L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the Fundamental concepts of Geomorphology, Weathering, Soil processes and Karst Topography
2. Discuss the geological structures formed by the Tectonic activities and the geological work done by a river and the various drainage systems
3. Predict the various forces acting in the Earth's and its resultant structural changes. The Geometry, Types and Mechanism of Folding, Faulting, Joints
4. Assess the theory of plate tectonics and describe how the outer part of the earth is broken into large fragments (plates) that are constantly in motion relative to each other.

DSC3: Geomorphology and Structural Geology

Unit	Description	Hours
1	**Geomorphology-1:** Geomorphic Processes; Exogenetic and Endogenic processes. Weathering; Physical weatheiring, Chemical Weathering, Biological Weathering. Soil Processes; Soil Profile, Climate and Soil Formation, Soil Types. Mass Wasting; Soil Creep and Solifluction, Earth and Mud Flows and Slides. Karst Topography, Tectonic Geomorphology, Fluvial Geomorphology and Depositional Landforms, Drainage Systems	10
2	**Geomorphology-2:** Shorelines; Classification of Coast and shoreline; Johnson's Classification of shorelines, Shepard's Classification of coast, Davies Classification. Shoreline Erosional Features, Transportation by Sea, Deposition by Sea. Features of Ocean basin floor (Mid Ocean Ridge, Deep Ocean Trenches, Abyssal Plains, Sea Mounts). Coral Reefs. Aeolian Geomorphology; Wind Erosion, Erosional Features, Wind Transport, Wind Deposits	10
3	**Geomorphology-3:** Types of Sand Dunes. Loess. Types of Eruption, Features of Lava fields, Features Associated with Volcanoes; Ash Showers, Volcanic Mudflows or Lahars, Plug Domes. Depression Forms; Craters, Calderas, Volcanic Tectonic Depression. Volcanic Plateaus and Plains. Glacial Geomorphology: Types of Glaciers, Movement of Glaciers, Glacial Erosion, Transport by Glaciers, Glacial Deposits. Geomorphology of India; Peninsular, Extra Peninsular, Indo Gangatic Plain	10
4	**Structural Geology:** Objectives of Structural Geology – Deformation Mechanisms: Mechanical Properties of rocks - Concepts and types of Stress and Strain. Introduction, Slaty cleave or schistosity, Fracture cleavage, Shear	11

	cleavage, Slip cleavage, Bedding cleavage, Axial plane cleavage. Foliation: Primary and secondary foliation. Lineation: Definition and kinds of lineation: Slickenside, Boudinage, Quartz rods, Mullion structure. Folds: Mechanism of Folding: Introduction – Types of folding- Causes of folding: Tectonic process - Non-tectonic process. Depressions and Culminations - Domes and Saddles - Profile of a Fold – Recognition of Folds in the field and map, Fault: Mechanism of faults. Joints: Mechanism of Joints	
5	**Unconformity:** Introduction - Kinds of Unconformities - Recognition of Unconformities - Distinguishing Faults from Unconformities – Radiogenic dating - Tectonism and sedimentation. Diapirs and Salt Domes – Recognition of Unconformity in the field and map. Lineament: Mapping and Analysis - Basin Tectonics - Microstructures and Structures of Sedimentation and Intrusion- Structural analyses - Principle and elements of Structural Analyses - Geometrical Analyses of simple and complex structure on mesoscopic and macroscopic scale. Geotectonics: Tectonic features of the Earth - Continental drift – Sea floor spreading - Plate Tectonics –Elements of Tectonism - Characteristics of Plates - World Plates - Plate Boundaries - Assumptions and Problems - causes and mechanism - Convection – Plate Tectonics	11

References:

1. Physical Geology. Carla. W Montgomery, Wm C. Brown Publishers, 1990
2. A Text Book of Geomorphology.Dayal.P, Rajesh Publication, New Delhi 2007
3. Principles of Geomorphology, W.D ThornburryWiley, 1969
4. Geomorphology. Charley, R.J., Suhumm, S.A &Sugden, D.E, Routledge, 1985
5. Earth: An Introduction to Physical Geology (10th Edition), Tarbuck, E.J., Lutgens,F.K& Dennis Tasa. Prentice Hall, 2010
6. Billings, M.P. Structural Geology. Prentice-Hall; 3Rev e. edition (April 1972)
7. Lahee. Field Geology. RareBooksClub.com (May 19, 2012)
8. Ramsay,J.G. Folding and fracturing of rocks. The Blackburn Press (February 2004)
9. Whitten,E.H.T. Structural Geology of folded rocks. Chicago, Rand Mcnally. 1966)
10. Badgley,P.C. Structural methods for the exploration geologist. Harper; First Edition edition (1959)
11. Martin Bott, H.P. The interior of the Earth. Edward Arnold (1971)
12. Manual of Field Geology- Robert R Compton. ohn Wiley & Sons, Inc. (1962)

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Dept Name: Applied Geology
Semester-I
DSC4: 24APG1C4L

Course Title: Stratigraphy and Palaeontology	Course code: 24APG1C4L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Evaluate the principles of advanced Stratigraphy, and details of Geological Time
2. scale
3. Identify Indian stratigraphic systems of Archean, Dharwar, Cuddapah, Kurnool, Vindhyan and Aravalli systems, The Paleozoic Group, The Tertiary Groups
4. Plan ways to systematic study of ancient forms of the life (fossils) and to Evolutionary Principles, and Paleontological Techniques
5. Outline of vertebrate palaeontology and micropaleontology.

DSC4: Stratigraphy and Palaeontology

Unit	Description	Hours
1	**Geological Time Scale:** Geological Time Scale and Indian Time Scale, Paleogeography and life of each period. Correlation: Physical and paleontological correlation method – Homotaxic, Contemporaneity and Syntaxis, Lateral variation and facies– code of stratigraphic nomenclature. Stratotypes and its requirements. Geological Succession, Structure, Tectonics and Economic Importance	10
2	**Elements of Stratigraphy:** Principles and Classification of Stratigraphy– Litho-, Bio-, chrono-, Magneto stratigraphy and their Applications– Elements of – Cyclostratigraphy, Allo-, Pedo-, Chemo- and Seismic Stratigraphy. Basic ideas of Sequence stratigraphy and Quaternary Stratigraphy. Bouma sequence. Stratigraphy Succession, Structure, Tectonics and Economic Importance	10
3	**Indian Stratigraphy:** Stratigraphic Distribution of the following; – Archaean system –Cuddapah system –Kurnool system – Vindhyan system – Aravalli system of India, Dharwar system– Sargur Supergroup, Sakoli Group – Sausar Group – Iron ore Group of Karnataka, Bihar and Orissa – Bundelkhand Group – Banded Gneiss complex, The Paleozoic Group. Deccan Traps: Distribution - Classification - Structure - Geological Succession – Inter- Trappean and Infra-Trappean beds- Bagh Beds, – Origin- Economic importance - Lameta beds - Age and Economic importance	11
4	**Palaeontology:** Brief out line of Geological time scale and Life through Ages - Fossils and Their Modes of Preservation - Origin and Evolution of life – Recent Theories - Species concepts – Phylogeny- Antogeny – Palingenesis - Invertebrate Paleontology: Morphology, Evolutionary Trends, Stratigraphic importance and application of: Trilobites - Graptolites – Corals – Brachiopods - Cephalopods	10

5	**Vertebrate Palaeontology:** Classification of Vertebrates – Study of evolution of Horse - Elephant and Man - Extinction of Dinosaurs. Palaeobotany: Methods of preservation of fossil plants - Objective and limitation of fossil Plants – Classification. Micropaleontology: Definition and Applications of Micropaleontology – Field and laboratory techniques of micropaleontology - Types of Microfossils - Foraminifers and Ostracods – General Morphological Characters - Classification	11

References:

1. Krishnan, M.S. (2009), Geology of India and Burma, 6th Edition, CBS Publishers and distributors.
2. Parbin SINGH. (1978), Engineering & general geology, fourth edition
3. Wadia, (1893) Geology of India, McGraw Hill Book Co.
4. Boggs,S (1987). Principles of Sedimentology and Stratigraphy, Merill Publishing Co. New York.
5. Ravindra Kumar, (2010) Fundamentals of Historical Geology and Stratigraphy of India, New Age International (p) Ltd.
6. Weller. A.K. (1988) Principles of Stratigraphy. Asia Publishing House. Delhi.
7. Gignoux, M (1960) Stratigraphical Geology, Mc Graw hill publications.
8. Henry Woods, (2005) Paleontology Invertebrate, The University Press
9. David M. Raupsteven, M., Stanley, Principles of Paleontology, New Delhi, 2004
10. Jain, P.C and Anantharaman, M.S., Paleontology: Evolution and Animal Distribution, 6th Edition, Vishal Publishing Co, New Delhi, 2005
11. Moore, R.C, Lalicker, C.G & Fisher, A.G., Invertebrate Fossils, 1st Indian Edition, CBS Publishers & Distributors, New Delhi, 1997
12. Raup And Stanely, Principles of Paleontology, CBS, 2004
13. Shrock & Twenhofel, Principles of Invertebrate Paleontology, CBS Publishers & Distributors, New Delhi, 2005

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Dept Name: Applied Geology
Semester-I
SEC1: 24APG1S1LP

Course Title: Field Geology and Cartography	Course code: 24APG1S1LP
Total Contact Hours: 03 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 01 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Discuss about the description of rocks and mineral investigations techniques.
2. Demonstrate the field equipments.
3. Explore the types of maps and cartography information.

SEC1: Field Geology and Cartography

Unit	Description	Hours
1	**Introduction:** Introduction of geological fields, types of geological maps, field softwares, GPS way points, Types of Scales, geological field equipments, readings of toposheets, line department maps, thematic maps, and field safety and measurements, field recordings, field notebook and documentation	08
2	**Field Geology:** Understanding of the compass and clinometers. Topographic maps, field observations at different scales, basic field procedures, specimens and samples, fossils and biogenic structures, recording features of sedimentary rocks and constructing graphic logs, recording features of igneous rocks, recording structural information, recording features of metamorphic rocks, making a geological mapping, recording numerical data and use of instruments in the field, photography, mineral investigation and identification	10
3	**Cartography:** Principles of cartography, Understanding the cartography, Cartography software's, free downloading of various cartography maps, important of maps, uses of maps, preparation of layout maps, legend, scale, arrow, title, grids etc	08

References:

1. Lahee. Field Geology, CBS Publishers, 1987
2. SM Mathur, Guide to Field Geology, PHI Learning Pvt. Limited, New Delhi-110092, Revised Edition 2010
3. Angela. L. Coe, Geological Field Techniques, Wiley-Blackwell publishing Ltd., UK, 2010

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Dept Name: Applied Geology
Semester-I

DSCL: 24APG1C1P

Course Title: Mineralogy Lab	Course code: 24APG1C1P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Discuss Students will have good training on identification of rock forming minerals and economic ores.
2. Identify the physical properties of industrial minerals.
3. Analyze the Ore minerals quantitatively.

DSCL: Mineralogy Lab

List of Experiments

1. Physical properties of Minerals
2. Optical properties of minerals
3. Study of minerals in hand specimen
4. Study of minerals in thin sections
5. Calculation of structural formula for important rock forming mineral groups
6. Determination of anorthite content and twin law in plagioclase feldspars
7. Stereographic projections – axial ratios – Napier's theorem and problems

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Dept Name: Applied Geology
Semester-I

DSCL: 24APG1C2P

Course Title: Geoinformatics Lab	Course code: 24APG1C2P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Hands on training of georeferenceing the maps, digitization of maps using GIS software.
2. Trained on various GIS tools.
3. Expert on prepare the maps using GIS tools.

DSCL: Geoinformatics Lab

List of Experiments

1. Introduction GIS software
2. Familiarization with GIS Software
3. Geo Referencing and Projections
4. Digitization of Map / Toposheet
5. Creating a Geo-database (Attribute Data) of maps
6. Creation of Thematic Maps
7. Preparation of Map Overlay
8. Layout Map Preparation
9. Data Conversion – Vector to Raster, Raster to Vector
10. Preparation of final output map and settings in the plotter

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Dept Name: Applied Geology
Semester-I

DSCL: 24APG1C3P

Course Title: Geomorphology and Structural Geology Lab	Course code: 24APG1C3P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Hands on training to use of various geological kits and toposheet readings.
2. Trained on professional aspects of geological mapping.
3. Expert on prepare the field structural maps.

DSCL: Geomorphology and Structural Geology Lab

List of Experiments

1. Identification and interpretation of geomorphology and structural elements in maps.
2. Preparation of drainage network maps, geological maps and section maps
3. Exercises on preparation of contours for different land forms
4. Determination of strike, true dip and apparent dip
5. Measurement of thickness and width of outcrops
6. Interpretation of three point problems, drawing of profiles
7. Exercises on construction of geological cross-sections, stratum contours, isopach maps
8. Study of geological map of Karnataka and India
9. Interpreting underground structure from borehole data
10. Recording and plotting of field data

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Dept Name: Applied Geology
Semester-II
DSC5: 24APG2C5L

Course Title: Igneous Petrology	Course code: 24APG2C5L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Designate about the magmatic process and formation of igneous rocks
2. Identify the different types of Igneous Rocks
3. Explain about the Rock formations and important rock descriptions
4. Assess the Petrography, nomenclature, classification and petrogenesis of important igneous rocks.

DSC5: Igneous Petrology

Unit	Description	Hours
1	**Petrology concepts:** Definition, Structure of the earth and origin of magmas. Earth's Layers of Differing Chemical composition and Physical properties. Rock Cycle, Characteristics of Magma. Magma differentiation. Crystallization of magma. Ascent and emplacement of magmas. Intrusive and extrusive igneous rocks. Textures of igneous rocks. General classification of Igneous rocks	10
2	**Origin and Genesis of Igneous rocks:** Petrology, Magmatic Differentiation and Other Processes, Principles of Geochemistry and Nature of Silicate Melts, Ocean-Floor Volcanism, Intraplate Volcanism, Island-Arc Volcanism, Magmatic Arcs of Continental Margins, Continental Flood Basalts, Layered Mafic Intrusions, mid oceanic ridge volcanism, Deccan basalt, basalt magmatism associated with subduction zone	11
3	**Important of igneous rocks:** Anorthosites, Albite, Fosterite, Diopside, Anorogenic Granites and Rhyolites, Alkaline rocks, ophiolites, carbonatites, lamprolite, kimberlite ,pegmatites and lamprophyres. Crystallization of basaltic and granitic magmas	10
4	**Phase diagrams & igneous rocks settings:** Definitions. GIBBS Phase Rule. Graphical representation of phase rule, One Component System-SiO2, H2O – Binary Pahse Diagram. Two component- Albite – Anorthite – Solid solution. Concept of Lever Rule. Concept of Tie Line, Eutectic system (Di – An)- Equilibrium Crystallization- Melting Behavior- Partial / Fractional melting. Incongruent melting. Solid solution systems. Exsolution. Ternary System (Di-An –Fo): Crystallisation in ternary systems	11
5	**Classification of Igneous rocks:** Criteria for classification of the igneous rocks; CIPW- norms classification, CIPW norm Calculations, Modal Analysis, Point Counting, , Niggli values, IUGS classification, IUGS-Basic mafic minerals, Phaneritic rocks with less than 90% mafic minerals, QAPF diagram – Calculations and plotting, Classification of Gabbroic rock, Rocks with more than 90% mafic minerals / ultamafic rocks, Ultramafic rocks	10

References:

1. Best M.G., Igneous and Metamorphic Petrology, 2nd ed. Blackwell. UK, 2002
2. Hall, Anthony, Igneous Petrology. Longman, UK1996
3. Tony Philpotts Principles of Igneous and Metamorphic Petrology, Cambridge University Press, UK, 2006.
4. Barth:- Theoretical Petrology
5. Bowen:- Evolution of Igneous Rocks
6. Turner and Verhoogan:- Igneous and Metamorphic Petrology
7. Carmicheal, Turner and Verhoogan:- Igneous Petrology
8. Hatch, Wells and Wells:- Petrology of Igneous rocks
9. Brain:- Igneous Petrology
10. Mc Berney :-Igneous Petrology
11. Bose:-Igneous Petrology

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Dept Name: Applied Geology
Semester-II
DSC6: 24APG2C6L

Course Title: Metamorphic Petrology	Course code: 24APG2C6L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Designate about the metamorphism process and formation of metamorphic rocks
2. Identify the different types of metamorphic Rocks
3. Explain about the rock formations and important rock descriptions
4. Assess the petrography, nomenclature, classification and important types of metamorphism.

DSC6: Metamorphic Petrology

Unit	Description	Hours
1	**Petrology concepts:** Definition, Nomenclature and description of metamorphic rocks. Basic concepts of metamorphic reactions. Types of metamorphism; Depth zones, metamorphic grades. Texture and structure of metamorphic rocks	10
2	**Phase diagrams:** Definitions. Phase Rule. Mineralogical phase rule of closed and open systems; application of phase rule. Diagrammatic representations of mineral reactions and mineral paragenesis – ACF, AKF, AFM diagrams	11
3	**Metamorphic facies:** Role of temperature, pressure and fluids in metamorphism; a detailed description of each facies of low pressure, medium to high pressure and very high pressure with special reference to characteristic metamorphic zones and subfacies. Facies classification and systematic description of regional and thermal metamorphism olitic, basic-ultabasic and impure calcareous rocks	11
4	**Metasomatism:** Metamorphic differentiation, metasomatism; anatexis and origin of migmatites; regional metamorphism and pair metamorphic belts in reference to plate tectonics. Ocean floor metamorphism, metamorphism related to ophiolites, metamorphism and continental collision	10
5	**Importants of metamorphic rocks:** Gneiss, Phyllite, Schist, slate, Hornfels, Marble, Quartzite, Novaculite, skarn, Anthracite, Soapstone	10

References:

1. Harkar:- Metamorphism
2. Turner:- metamorphic Petrology
3. Winkler:- Petrogenesis of metamorphic rocks
4. Miashiro:- Metamorphism and metamorphic rocks
5. Turner and Verhoogan:- Igneous and Metamorphic Petrology
6. Philipots:- Igneous and Metamorphic Petrology
7. Bucher and Feg:- Petrogenesis of metamorphic rocks
8. Best M.G., Igneous and Metamorphic Petrology, 2nd ed. Blackwell. UK, 2002

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Dept Name: Applied Geology
Semester-II
DSC7: 24APG2C7L

Course Title: Sedimentary Petrology	Course code: 24APG2C7L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Designate about the sedimentalogy process and formation of sedimentary rocks
2. Identify the different types of sedimentary Rocks
3. Explain about the rock formations and important rock descriptions
4. Assess the petrography, nomenclature, classification and important types of sedimentary processes.

DSC7: Sedimentary Petrology

Unit	Description	Hours
1	**Sedimentary petrology concepts:** Definition, Weathering and erosion process, products, principles of sedimentation process, scope, applications. Processes of transport and formation of sedimentary rocks; classification of sedimentary rocks. Basin forming processes	10
2	**Sedimentology:** Definition, measurement and interpretation of grain size, roundness and sphericity, paleocurrent analysis. Sedimentary textures, structures-primary, secondary and biological structures. Provenance studies, diagenesis of sediments, frame work matrix and cement of terrigenous sediments	11
3	**Sedimentary facies and basins:** Facies modelling for marine, non-marine and mixed sediments, tectonics and sedimentation, cyclic sediments. Structure contours and isopach map. Description of sedimentary basins of India, classification, interpretation to the depositional environment	10
4	**Sedimentary rocks:** Description of Siliciclastic, argillaceous and carbonate sedimentary rocks: origin, diagenesis and depositional environment of sandstones, conglomerate, breccias, shale, limestone and dolomite. Carbonaceous sedimentary rocks: evaporates, cherts, phosphorites and iron bearing sedimentary rocks	11
5	**Sedimentary environments:** Continental environments – alluvial, lacustrine, desert- aeolion and glacial sedimentary systems. Marginal marine environments – deltaic, beach and barrier- islands, estuarine and lagoonal, tidal –flat system	10

References:

1. Tucker, M.E., Sedimentary Petrology, Blackwell Science U.K., 2001
2. F.J. Pettijohn., Sedimentary Rocks third edition, CBS Publishers & Distributors, Reprint 2002
3. Sam Boggs, Principles of Sedimentology and Stratigraphy. Pearson, USA, 2000.
4. Donald R. Prothero, Frederic Schwab., Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy W H Freeman, USA, 2003.

5. A. Bhattacharyya, C. Chakraborty., Analysis of sedimentary Successions.,Oxford and IBH Publishing Co. Pvt Ltd, New Delhi,2000
6. Mike D Blum,Susan B. Marriot, Suzanne F.Leclair, Fluvial Sedimentology ,2005., Blackwell Publishing.,London
7. Kenneth J Hsu., Physics of Sedimentology, 2004, 2nd edition.,
8. Michael McLane Sedimentology, 1995., Oxford University Press, London
9. Allen, J.R.L: -Principles of physical sedimentation
10. Nichols, G.: -Sedimentology and Stratigraphy
11. Reading, H.G.: -Sedimentary environments
12. Reineck, H.R. and Singh, I.B.:-Depositional sedimentary environments
13. Miall, A.D.: -Principles of sedimentary basin analysis
14. Eincele,G.:-Sedimentary basins
15. Sengupta, S. M.: Introduction to Sedimentology

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Dept Name: Applied Geology
Semester-II
DSC8: 24APG2C8L

Course Title: Applied Ore Geology	Course code: 24APG2C8L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the process of ore formations
2. Identify the different types of ore minerals
3. Explain about the ore formations and important Indian ore minerals descriptions
4. Assess the ore genesis, occurrence and distributions of metallic ore and industrial ore minerals.
5. Discuss the Salient Metallic and non metallic mineral groups

DSC8: Applied Ore Geology

Unit	Description	Hours
1	**Concepts of ore deposits:** Various process – Magmatic Concentration – Sublimation – Contact Metasomatism – Hydrothermal Process – Sedimentation – Bacterial process – Submarine exhalative and volcanic process – Evaporation – Residual and Mechanical concentration – Oxidation and Supergene Enrichment – Metamorphism – Classification of mineral deposits – Controls and Localization of Mineral Deposits – Metallogenic Epochs and Provinces – Geological Thermometry and barometry for Ore minerals	10
2	**Classification of ores:** Magmatic ore, hydrothermal ore, Oxide ores, metallic ores, non-metallic ore, industrial ores, precious ores, sulphide ores, laterite ores, silicate ores, ferrous and non-ferrous ores residual ore, carbonate ore, etc	10
3	**Indian ore types:** Petrological ore associations with Indian examples wherever feasible: Orthomagmatic ores of mafic- ultramafic associations – diamond in kimberlite; REE in corbonatites; Ti- V ores; chromite and PGE; Ni ores; Cyprus type Cu- Zn ores of silicic igneous rocks- Kiruna type Fe- P; pegmatites; greisens; skarn. Ore of sedimentary affiliation- chemical and clastic sedimentation; stratiform and stratabound ores deposits(Mn, Fe, non-ferrous ores); places; ores of metamorphic affiliation- metamorphism of ores; ore related to weathering- laterite, bauxite, Ni/ Au laterite	11
4	**Study of Important Metallic Minerals:** Study of following Metallic Mineral Deposits and their Origin, Occurrence & Distribution in India and Uses – Platinum – Gold – Silver – Aluminum – Iron – Manganese – Chromium – Vanadium – Molybdenum – Tungsten – Nickel – Cobalt – Titanium – Copper – Lead – Zinc – Magnesium minerals	10
5	**Study of Important Non-Metallic Minerals:** Origin, Occurrence, Distribution in India and Uses of: Asbestos – Mica – Baryte – Talc – Ceramic Minerals – Building Stones – Cement Raw Materials – Mineral Pigments –	11

	Refractory Materials – Abrasive Minerals – Fertilizer Minerals and Gemstones	

References:

1. The Geology of Ore Deposits – Gillbert and Park. 2007, Waveland Press
2. Interpretation of ore Texture- Bastin E S. 1950Geological Society of America.
3. A.M. Evans (1987): - An introduction to ore geology
4. Evans (1993): - Ore Geology and Industrial Minerals
5. Economic mineral deposit- Mead LeRoyJensen&Alan Mara Bateman. 1981. Wiley.
6. Ore Microscopy – Cameron E N.1961. Wiley,
7. Geology of Mineral deposits- Smirnov,V.I. 1976. Mir Publishers
8. Ore Petrology – Stanton R L. 1972. McGraw-Hill
9. Park and Mac Diarmid (1975): - Ore deposits
10. Ore Microscopy and Ore Petrography – Craig and Vaughan. 1994. Wiley
11. India‟s Mineral resources – Krishnaswami S. 1979. Oxford & IBH
12. Mineral Resources of Karnataka – B.P Radha Krishna. 1996. Geological Society of India
13. Industrial minerals and rocks – S Deb. 1980. Allied Publishers
14. Introduction to ore forming processes-Laurence Robb.2005. Blackwell Science. Ltd
15. Ore Geology and Industrials Minerals: an Introduction- A.M. Evans. 1993. John Wiley & Sons
16. Understanding Mineral deposits-Misra,K.C.2000. Kluwer Academic Pub.
17. Gaudin, A.M. (1974) Principles of mineral dressing, Tata McGraw Hill.

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Dept Name: Applied Geology
Semester-II

SEC2: 24APG2S2LP

Course Title: Digital Image Processing	Course code: 24APG2S2LP
Total Contact Hours: 03 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 01 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Discuss about the description of DIP techniques.
2. To perform the satellite image processing and interpret the images for possible earth resources.

SEC2: Digital Image Processing

Unit	Description	Hours
1	**Introduction of Images:** Introduction to image, types of image and data, vector image, raster image, image data collection, image data analysis, image data collection errors, Remote sensing data requirements, image processing functions, image data formats	08
2	**Image Processing:** Image quality assessment: Image enhancement: Image reduction and magnification, contrast enhancement- linear and nonlinear enhancements, Image Rectification and Restoration. Band ratioing, spatial filtering- spatial convolution filtering, Fourier transformation, principal component analysis. Supervised classification. Unsupervised classification	10
3	**DIP Practice:** Interpretation of Images; Registration. Transfer of Information from Imagery to Base Map; Classification; Exposure to various Image Processing Techniques and Generation of digitally processed outputs	08

References:

1. John R Jensen Remote Sensing of the Environment: An Earth Resource Perspective (2nd Edition). Prentice Hall; 2 edition (May 11, 2006)
2. James B. Campbell. Introduction to Remote Sensing, Fifth Edition. The Guilford Press; Fifth Edition, Fifth Edition edition (June 21, 2011)
3. David P. Paine, James D. Kiser. Photography and Image Interpretation. Wiley; 3 edition (February 14, 2012)
4. Robert H. Webb PhD, Diane E. Boyer and Raymond M. Turner Dr. Repeat Photography: Methods and Applications in the Natural Sciences. Island Press; 1 edition (November 15, 2010)

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Dept Name: Applied Geology
Semester-II

DSCL: 24APG2C4P

Course Title: Igneous and Metamorphic Petrology Lab	Course code: 24APG2C4P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Identify the igneous and metamorphic rocks
2. Evaluate the microscopic properties of Igneous and Metamorphic rocks.

DSCL: Igneous and Metamorphic Petrology Lab

List of Experiments

Igneous petrography:

1. Study of igneous rocks in hand specimen
2. Study of igneous rocks in thin sections;
3. Structures and textures in igneous rocks;
4. Calculation of CIPW norms and Niggli values;
5. Plotting of chemical data on different variation diagrams for evaluation of magma and rock types; Study of IUGS classifications;
6. Preparation of igneous rock slides.

Metamorphic petrography:

1. Study of metamorphic rocks in hand specimen;
2. Study of metamorphic rocks in thin sections;
3. Structures and textures in metamorphic rocks;
4. Interpretation of reaction texture;
5. Plotting of chemical data on ACF, AKF and AFM diagrams;
6. Preparation of metamorphic rock slides

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VSK University PG Centre
Nandihalli, Sandur-583 119
Ballari (Dist)

Dept Name: Applied Geology
Semester-II

DSCL: 24APG2C5P

Course Title: Sedimentary Petrology Lab	Course code: 24APG2C5P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Identify the sedimentary rocks
2. Evaluate the microscopic properties of sedimentary rocks.

DSCL: Sedimentary Petrology Lab

Sedimentary petrography:

1. Study of sedimentary rocks in hand specimen;
2. Study of sedimentary rocks in thin section;
3. Study of grain-size analysis
4. Graphic Representation and Interpretation.
5. Sedimentary structures in hand specimen;
6. Aerial photographs and field exercises related to palaeocurrent data from different environments;
7. Exercises related to analysis and interpretation of depositional sedimentary environments; Preparation of thin section of sedimentary rocks.

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Dept Name: Applied Geology
Semester-II

DSCL: 24APG2C6P

Course Title: Applied Ore Geology Lab	Course code: 24APG2C6P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Identify the ores and ore minerals
2. Evaluate the microscopic properties of ores and ore minerals.

DSCL: Applied Ore Geology Lab

List of Experiments

Study of Ores and ore minerals:

1. Megascopic study of structures and fabrics of different ores and their associations;
2. Mineralogical and textural studies of common ore minerals under petrological microscope and ore microscope;
3. Exercises on the determination of reflectivity and micro-hardness of common ore minerals;

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Dept Name: Applied Geology
Semester-III
DSC9: 24APG3C9L

Course Title: Exploration Geology	Course code: 24APG3C9L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the exploration techniques.
2. Demonstrate the Geophysical and Geochemical exploration methods.
3. Ore estimations and reserve calculation.
4. Explain the prospecting and exploration methods

DSC9: Exploration Geology

Unit	Description	Hours
1	**Introduction of Exploration:** Definition of mineral. Resource reserve definitions, Mineral resources in industries. Geological criteria for mineral prospecting. Indications of ore. Geological prospecting methods. Small and large scale geological mapping. Methods of geological exploration	10
2	**Prospecting and Exploration:** Principles of mineral exploration, Prospecting and exploration- conceptualization, methodology and stages, Sampling techniques, subsurface sampling including exploratory grids, location and documentation of exploratory workings (pits, trenches underground workings)	10
3	**Geochemical Exploration:** Geochemical cycle, mobility of elements and geochemical anomaly. Mode of occurrence of trace elements. Primary dispersion patterns of deep seated origin, syngenetic and epigenetic. Geochemical rock surveys. Weathering and its products. Mobility of elements in the surficial environment and surficial dispersion patterns and forms. Anomalies in residual and transported over burden. Anomalies in waters and drainage sediments	10
4	**Geophysical exploration:** Geophysical anomalies, Electrical prospecting: Resistivity method, important electrode arrangements, instruments, interpretation and application of electrical methods in ground water investigation. Magnetic prospecting: Magnetic properties of rocks and minerals, Earth's magnetic field, instrument and measurements, interpretation of magnetic anomalies. Gravity prospecting: Earth's gravity field, regional and local gravity anomalies, instruments, interpretation of gravity anomalies	12
5	**Data Evaluation and Reserve estimations:** Evaluation of sampling data Mean, mode, median, standard deviation and variance. Principles of reserve estimation, density and bulk density Factors affecting reliability of reserve estimation Reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks) Regular and irregular grid patterns	10
References:		

1. Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration.
2. M B Ramachandra Rao: Outlines of geophysical prospecting - A manual for geologists.
3. Milton B Dobrin: Introduction to geophysical prospecting
4. Rose, A.W Hawkes. H.E & Webb J.S. 1979: Geochemistry in mineral exploration
5. Jakaosku J J: Exploration geophysics.
6. P V Sharama: Geophysical Methods in Geology
7. Bhimasanakaran and Gaur: Exploration Geophysics for geologist and Engineers.
8. D S Paransis: Principles of Applied Geophysics.
9. C H Howel: Introduction to Geophysics
10. Ginzburg. I.I Principles of geochemical prospecting

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Dept Name: Applied Geology
Semester-III
DSC10: 24APG3C10L

Course Title: Hydrogeology	Course code: 24APG3C10L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the groundwater flow through earth system
2. Demonstrate the skill to interpret potential for exploration of groundwater.
3. Analyze the Groundwater Basins and rain water harvesting methods
4. Explain properties of surface and subsurface water.

DSC10: Hydrogeology

Unit	Description	Hours
1	**Introduction of Hydrology:** Scope of Hydrologic cycle, hydrograph, origin and source, distribution of groundwater, aquifers, aquifer compressibility, porosity, rock properties, specific yield, storage coefficient, groundwater occurrence in various geological formations, geological structures. Hydrology of India	11
2	**Groundwater Flow:** Darcy's law; validity of Darcy's law, hydraulic gradient, hydraulic conductivity, field mapping, flow nets, K estimation in lab and by tracer techniques, transmissivity, homogeneity and heterogeneity, isotropic and anisotropic formations, groundwater resources evaluation, unsaturated flow	11
3	**Aquifer Parameters:** General groundwater flow equation, steady and unsteady radial flow towards wells, confined, unconfined and semi confined aquifers, impact of boundaries, multiple wells, estimation of aquifer parameters by pump tests, slug tests, well loss, groundwater recharge, groundwater modeling	10
4	**Groundwater Development:** Advantage of groundwater use. Construction of wells, shallow and deep wells, methods of well completion and development, testing for yield, safe yield, horizontal wells, galleries, interference between wells and aquifer boundaries, aquifer response to pumping, land subsidence. Groundwater recharge	10
5	**Groundwater Quality:** Constituents in groundwater, dissolved ions, chemical analysis, reporting of results, groundwater quality for various uses, geochemical evolution of groundwater, sources of contaminants, solute and particle transport, remediation, seawater intrusion. Case studies	10

References:

1. Domenico P.A. and F.W. Schwartz (1990), Physical and chemical hydrogeology. John Wiley.
2. Fetter,C. W (1994): Applied Hydrogeology,(3rd edition),New York,Macmillan

3. Freeze, R.A and Cherry, J.A (1979), Groundwater, Prentice Hall
4. Elango, L and Jayakumar, R (Eds.) (2001) Modelling in Hydrogeology, Unesco-IHP Publications, Allied Publ.
5. Elango, L (Ed.) (2011) Hydraulic conductivity – Issues, Determinations and applications, Intech Open Acces Publishers, ISBN 978-953-307-288-3, 434 P
6. Todd, D.K Groundwater Hydrology, John Wiley
7. Hiscock, K, Hydrogeology (2005): Principles and Practice, Wiley-Blackwell.
8. C.F.Tolman: Groundwater
9. S.N.Davis and R.J.M Dewiest: Hydrology
10. R.H.Brown and others: Groundwater Studies

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Dept Name: Applied Geology
Semester-III

DSE1: 24APG3E1L-A

Course Title: Indian Mineral Deposits	Course code: 24APG3E1L-A
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the process of Ore formation
2. Demonstrate the skill to Salient Metallic mineral groups.
3. Analyze the Mineral economic strategies

DSE1: A). Indian Mineral Deposits

Unit	Description	Hours
1	**Introduction and Definitions:** Ores, gangue minerals, tenor, grade and lodes Resources and reserves; Use of various minerals in industries; Production and its effect on prices of minerals; Demand and supply, their effect on prices; Mineral resources in India and their present status and future development	11
2	**Metallic mineral resources:** Study of the following Indian ore deposits with reference to their mineralogy, mode of occurrence, origin, geological association and geographical distribution: Iron, manganese, gold, aluminium, chromium, copper, lead and zinc	10
3	**Non-metallic mineral resources:** Study of the following mineral deposits with reference to their mineralogy, mode of occurrence, origin, geological association and geographical distribution in India: Minerals used in ceramics, cosmetic, glass, fertilizers, cement, chemical, paints and pigments, electrical and gemstone industries	10
4	**Metallurgy application mineral resources:** Study of the following Indian ore deposits with reference to their mineralogy, mode of occurrence, origin, geological association and geographical distribution: Tin, tungsten, titanium, nickel and molybdenum; Minerals used in metallurgical, refractory and abrasive industries	11
5	**Karnataka and Indian mineral resources:** Study of the Important Karnataka and Indian ore deposits with reference to their mineralogy, mode of occurrence, origin, geological association and geographical distribution: Iron, manganese, gold, silver, chromium	10

References:

1. Babu, T.M. (1994) Tin in India, Geological Society of India, Bangalore.
2. Babu, T.M. (1998) Diamonds in India, Geological Society of India, Bangalore.
3. Banerjee, D.K. (1992) Mineral Resources of India, The World Press Pvt. Ltd., Kolkata
4. Deb, S. (1980) Industrial Minerals and Rocks of India, Allied Publishers, New Delhi.
5. Karanth, R.V. (2000) Gems and Gem Industry in India, Geological Society of India,

Bangalore.
6. Krishnaswamy, S. (1979) India's Mineral Resources, Oxford and IBH, New Delhi.
7. Radhakrishnan, B.P. and Curtis, L.C. (1999) Gold in India, Geological Society of India, Bangalore.
8. Sharma, N.L. and Ram, K.S.V. (1964) Introduction to India's Economic Minerals, Dhanbad Publishers

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Dept Name: Applied Geology
Semester-III
DSE1: 24APG3E1L-B

Course Title: Experimental Mineralogy and Petrology	Course code: 24APG3E1L-B
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Explain the principles of Experimental mineralogy and petrology
2. Discuss about the concepts of thermodynamics
3. Demonstrate the skill to Raoult's Law and Henny's Law.
4. Analyze the Oxidation reaction

DSE1: B). Experimental Mineralogy and Petrology

Unit	Description	Hours
1	**Experimental Mineralogy:** Ore mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry. Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria	12
2	**Experimental Petrology:** High Temperature, Pressure Techniques, Hydrothermal apparatus and Piston Cylinder, Experiments on Solid, Solid Dehydration and Decarbonation Reaction	10
3	**Thermodynamics:** Gibb's Energy and equilibrium constant, mole fraction, activity coefficients. Regular and sub regular solutions. Standard states, fugacity and activity	10
4	**Raoult's Law, Henny's Law:** Heat Capacity, Evaluation and tabulation of thermodynamic data. Isobaric thermal expansion and pressures	10
5	**Geothermometers and geobarometers:** Calibrations of Geothermometers and geobarometers from thermodynamic and experimental data. Reduced activity of water from dehydration reactions. Log O_2 from oxidation reactions	10

References:

1. Chatterjee.N.D.(1991) Applied Mineralogical Thermodynamics. Springer Verlag.
2. Koch, G.S and Link, R.F. (1970) Statistical Analysis of Geological Data. John Wiley.
3. Powell, R. (1978) Equilibrium Thermodynamics in Petrology, an Introduction, Harper& Row
4. Wood, B.J. and Frasser, D.G (1976) Elementary Thermodynamics for Geologists. Oxford Univ. Press

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Dept Name: Applied Geology
Semester-III

DSE1: 24APG3E1L-C

Course Title: Marine Geology	Course code: 24APG3E1L-C
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept of Marine geology
2. Preparation of man power to address the ocean resources and environment
3. Demonstrate the skill to identify the suitable remote sensing applications in ocean sciences.

DSE1: C). Marine Geology

Unit	Description	Hours
1	**Physical features of the ocean:** Introduction and scope of Marine Geology; oceanic profile, oceanic features; beaches, coastal classification, erosion and accretion; waves, currents and tides, coastal protection structures	10
2	**Ocean resources:** Classification of marine mineral deposits. Origin and depositional system of marine resources; beach placers, shelf deposits, deep ocean Phosphatic, Polymetallic nodules, sulfate deposits, hydrocarbon deposits Sea water as a resource	10
3	**Oceanographic instrumentations:** Descriptions of research vessels, cruise, position fixing in the sea; sampling devices. Grab samplers, bottom samplers, dredges, sediment traps, boomerang samplers, water samplers, Winches, temperature measurement instruments, tools for studying ocean floor topography. POD, COD, GOD and BOD tools kit	12
4	**Sea water and marine pollution:** Concept of sea level changes, physical and chemical properties of seawater. Marine pollutionpathways, residence time, pollutants in the marine environment	10
5	**Oceanic crust, sediments and law of the sea:** Origin of oceanic crust, ocean sediments, classification, digenesis, Ocean tectonics. Law of the sea, EEZ. Fundamentals of Remote sensing applications to ocean science	10

References:

1. J.J. Bhatt. Oceanography(1994): Exploring the Planet Ocean. D. Van. Nostrand Company, New York,
2. Shepard, F. P. (1994): Submarine Geology, Harper and Row Publ. New York.
3. Kerth. S (1996): Ocean Science, John Wiley and Sons. Inc. New York.
4. James, K, Marine geology Prentice Hall, Inc. Englewood Clifs. N. J. 07632.
5. Eric. C. Bird Coasts (1984): an introduction to coastal geomorphology, III ed. Basil Black well Publ.

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Dept Name: Applied Geology
Semester-III
DSE2: 24APG3E2L-A

Course Title: Ore Dressing Technology	Course code: 24APG3E2L-A
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):
At the end of the course, students will be able to:

1. Describe the concept of ore dressing
2. Preparation of man power to address the mineral processing technology
3. Demonstrate the skill to identify the suitable flow sheets for ore dressing

DSE2: A). Ore Dressing Technology

Unit	Description	Hours
1	**Introduction:** Definition: Nature and Scope of mineral dressing; Relation of ore dressing to smelting and utility; Properties of minerals in relation to their dressing. Ore microscopy usage in mineral technology, information from mineralogical studies, mineral dressing processes	10
2	**Liberation:** Practice of crushing and grading and grinding; Working principles of Jaw, Gyratory, Cone and roll crusher; Stamp, Rod and Ball Mills	10
3	**Concentration, screening and sizing:** Concentration processes such as preliminary washing and sorting; Heavy fluid separation; Use of Classifiers (Hydraulic and Pneumatic); Jigging; Tabling, Floatation and Agglomeration; Electrostatic, Centrifugal and Maganetic separation; Amalgamation and heat treatment methods; Concentration of ores by chemical leaching; Process of dewatering, filteration, drying and thickening methods, dressing systems and plants	12
4	**Flow sheets of common types of ores:** Methods of dressing of iron, gold, manganese, chromium, coal, clays, flurospar, graphite, micas, gypsum, talc, barite etc. Flow sheets of important concentration plants of India	10
5	**Experimental Study:** Mechanical analysis by sieving, size analysis under microscope. Separation of minerals by panning and tabling. Preparation of flow sheets of the important concentration plants of India and flow sheets of common types of ores	10

References:

1. Gaudin, A.M. (1974) Principles of mineral dressing, Tata McGraw Hill.
2. Kelly, E.G. and Spottiswood, D.J. (1982) Introduction to mineral processing, John Wiley.
3. Taggart, A.F. ( ) Hand book of mineral dressing.
4. Wills, B.A. (1992) Mineral processing technology, Pergmon Press.

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Dept Name: Applied Geology
Semester-III

DSE2: 24APG3E2L-B

Course Title: Watershed Management	Course code: 24APG3E2L-B
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept watershed
2. Preparation of man power to address the watershed plans
3. Demonstrate the skill to identify the suitable water harvesting technology.

DSE2: B). Watershed Management

Unit	Description	Hours
1	**Introduction:** Definition, concepts of watershed, major objectives of watershed management, effects of watershed on community, ecosystem, Monitoring and evaluation of watershed	10
2	**Principles of watershed management:** Delineating the watershed. natural processes at work in watershed, common elements of watershed management, multidisciplinary approach in watershed management, participatory resources mapping and appraisal, benefits of watershed approach	11
3	**Degradation agents in watershed:** Flood, drought, fire, wind storms, erosion and deposition. Climate change. Glacial movement, Tectonic activity. Volcanic eruption. Human–induced changes. Impact of the degradation of watersheds in hydrology	11
4	**Engineering measures for soil conservation:** Rainfall parameters. Types of soil erosion. contour bunding, Surplusing structures contour and straggled trenching, gully control structures, graded bunding, bench terracing, land leveling and grading	10
5	**Water Conservation and Harvesting:** Water conservation methods for crop land, Treatment of catchments. Rainwater harvesting structures: Check dam, farm pond, percolation tank, basin, ditch and furrow, channel, flooding, irrigation, subsurface dyke, nalla bund and pit methods. Conjunctive use of surface and groundwater	10

References:

1. Rajora,R.,(1998),Integrated Watershed Management, Rewat Publications, New Delhi.
2. Tideman.E.M., (1996), Watershed Management: Guideline for Indian Conditions, Omega Scientific Publishers, 372p..
3. Lal.S., (2004), Watershed, Development, Management and Technology, Mangal Deep Publications, 358p..
4. Suresh,R.,(2002), Soil and Water Conservation Engineering, Standard Publishers and Distributers, Delhi.
5. Kakade,B.K.,(2002), Soil and Water Conservation Structures in Watershed Development Progarmmes ,BAIF Development Research Foundation, Pune

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Dept Name: Applied Geology
Semester-III

DSE2: 24APG3E2L-C

Course Title: Energy Resources	Course code: 24APG3E2L-C
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept hydrocarbon deposit
2. Preparation of man power to address the oil and gas industry
3. Demonstrate the skill to identify the suitable coal for energy utilization

DSE2: C). Energy Resources

Unit	Description	Hours
1	**Origin of Coal:** Sedimentology of coal bearing strata; Structures associated with coal seams; Proximate and Ultimate analysis of coal; Rank, grades and types of coal; Indian and International classification for coking and non-coking coals; Coal preparation: coal carbonization, coal gasification, underground coal gasification (UCG), coal hydrogenation and coal combustion	10
2	**Coal petrology:** concept of 'lithotype', 'maceral' and 'microlithotype; Classification and optical properties of macerals and microlithotypes; Techniques and methods of coal microscopy; Reflectance and fluorescence microscopy; Application of coal petrology for different industrial purposes; Geological and geographical distribution of coal and lignite deposits in India; Coal exploration and estimation of coal reserves; Indian coal reserves and production of coal in India; Coal Bed Methane (CBM); Generation, retention and exploration of methane from coal beds	11
3	**Petroleum:** Different states, natural occurrences, chemical composition and physical properties of different fractions; Origin of Petroleum: Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen; Migration of oil and gas; Reservoir rocks: General attributes and petrophysical properties; Classification of reservoir rocks-fragmental reservoir rocks and chemical reservoir rocks; Reservoir fluids-water, oil and gas; Hydrocarbon traps: Structural, stratigraphic and combination traps; Cap rock: Definition and general properties; Petroliferous basins of India; Elements of petroleum exploration; Hydrocarbons: Present status and future prospects	11
4	**Hydrocarbon deposits:** Plate tectonics and its implication in Petroleum, future thrust areas. Sequence stratigraphy and its implications in Petroleum exploration. Application of logging and seismic techniques in Petroleum exploration. Geochemical prospecting in petroleum exploration. Unconventional sources of energy	10

5	**Nuclear energy:** Mineralogy and geochemistry of radioactive minerals; Mode of occurrence, origin, association and distribution of atomic minerals in nature (U, Th, Be, rare metals and REE etc); Atomic minerals as source of energy; Uranium and thorium exploration in India; Productive geological horizons in India; Atomic fuels and environment; Nuclear power stations of India and future prospects; Potential alternative (renewable) energy sources such as Geothermal, solar, wind, tidal, biomass, etc	10

References:

1. Acharyya, S.K. (2000) Coal and Lignite Resources of India: An overview, Geological Society of India, Banglore.
2. Chandra, D., Singh, R.M. and Singh, M.P. (2000) Textbook of Coal (Indian Context), Tara Book Agency, Varanasi.
3. Francis, W. (1961) Coal, Edward Arnold Ltd.
4. Scott, A.C. (1987) Coal and Coal-bearing strata: Recent Advances, Blackwell Scientific Publications.
5. Singh, M.P. (Ed.) (1998) Coal and Organic Petrology, Hindustan Publ. Corp., New Delhi.
6. Stach, E. et al. (1975) Stach's textbook of coal petrology, Berlin: Gebruder Borntraeger.
7. Taylor, G.H., Teichmüller, M. and Davis, C. (1998) Organic Petrology: A new handbook incorporating some revised parts of Stach's Textbook of Coal Petrology.
8. Taylor, G.H., Teichmuller, M., Davis, A., Diessel, G.F.K., Littke, R. and Robert, P. (1998) Organic Petrology, Gebruder Borntraeger, Stuttgart.
9. Thomas, Larry (2002) Coal Geology, John Wiley and Sons Ltd., England
10. Van Krevelen, D.W. (1993) Coal: Typology-Physics-Chemistry-Constitution, Elsevier Science, Netherlands.
11. Holson, G.D. and Tiratsoo, E.N. (1985) Introduction to Petroleum Geology, Gulf Publ. Houston, Texas.
12. Leverson, A.L. (1970) Geology of Petroleum, Freeman and Company.
13. North, F.K. (1985) Petroleum Geology, Allen and Unwin.
14. Selley, R.G. (1998) Elements of Petroleum Geology, Academic Press.
15. Tissot, B.P. and Welte, D.H. (1984) Petroleum Formation and Occurrence, Springer-Verlag.
16. Aswathanarayana, U. (1985) Principles of Nuclear Geology, Oxford Press.
17. Boyle, R.W. (1982) Geochemical Prospecting for Thorium and Uranium Deposits, EIsevier.
18. Dahlkamp, F.J. (1993) Uranium Ore Deposits, Springer Verlag.
19. Durrance, E.M. (1986) Radioactivity in Geology, Principles and Application, Ellis Hoorwool.

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Dept Name: Applied Geology
Semester-III

GEC1: 24APG3G1L-A

Course Title: Study of Geoscience	Course code: 24APG3G1L-A
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of rocks and mineral investigations techniques.
2. Demonstrate the field geology.
3. Explore the geological time scale.

GEC1: A). Study of Geoscience

Unit	Description	Hours
1	**Physical Geology:** Introduction to Geoscience. Origin of the Earth. Age of the earth. Interior of the Earth. Geomorphic processes and cycles, Geological action of wind, water, glaciers. Volcanoes and earthquakes. Morphology of Oceans, Principles of Isostacy and uniformitarinism	08
2	**Structural Geology:** Petrology, Mineralogy, Rock deformation. Earth forces. Folds and Foldings, Fault and Faulting, Joints, Cleavage, Unconformities, Concepts of plate tectonics, sea floor spreading and geosynclines	08
3	**Stratigraphy:** Introduction, Definition of Stratigraphy, Branches of Stratigraphy and its relation ith other branches of Geology, Principles of Stratigraphy- Law of Uniformatianism, Law of order of superposition, Law of Faunal Succession.Geological Record and its nature Eon, Era, Period. Geological Time Scale. Classification of Standard Stratigraphic scale. Nomenclature and units-Litho, Bio and Chrono stratigraphic units, Correlation- Lithostratigraphic and Biostratigraphic	10

References:

1. Arthur Holmes: Physical Geology
2. Billings: Structural Geology
3. P.K. Mukerjee: General Geology
4. Strahler: Physical Geology
5. Weller: Stratigraphic Principles and Practice
6. Kumberlein and Sloss: Stratigraphy

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Dept Name: Applied Geology

Semester-III

GEC1: 24APG3G1L-B

Course Title: Study of Geoinformatics	Course code: 24APG3G1L-B
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of RS-GIS and GPS.
2. Demonstrate the Remotes Sensing techniques.
3. Explore the GIS and GPS tools.

GEC1: B). Study of Geoinformatics

Unit	Description	Hours
1	**Remote Sensing:** Introduction: History and Development of Remote Sensing, Fundamental Principles of Remote Sensing- Stages in Remote Sensing Process. Types of Remote Sensing- Advantages of Remote sensing, Aerial Photographs, Basics, Stereo models, Photo Mosaics and Photo scale. Electro Magnetic Radiation (EMR): EMR Spectrum – EMR Interaction with Atmosphere: Absorption, Scattering & Atmospheric windows	10
2	**Geographic Information System:** Introduction to GIS. Type of data, spatial and non spatial data, data structure, vector and raster formats, hardware for GIS, scanner, digitizer, standard GIS packages, database concepts, data input, retrieval. Assigning rank and weightage for geologic studies, overlay analysis	08
3	**Global Navigation Satellite System (GNSS):** Introduction, Satellite, Control and User Segments, Signal Components, Errors in GNSS observations, PS positioning, Differential GNSS. GNSS Mapping: Conventional Static, Kinematic GNSS Semi kinematic (Stop & Go), Rapid static Mobile mapping	08

References:

1. D.R.Lueder. Aerial photographic interpretation, Principles and applications. McGraw-Hill New York. (1959)
2. Anji Reddy, M. (2012) Textbook of Remote Sensing & GIS, BS Publications,Hyderabad
3. Photogeology - Miller, J.C.
4. Manual of photogrammetry - Ed: MorrieM.Thompson.
5. Manual of Remote sensing - Ed: Robert G Reeves.
6. Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern.
7. Remote sensing in Geology - Parry S. Siegal& Alan. R.Gillespie
8. Manual of photographic interpretation - Ed: Colwell, R.N.

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Dept Name: Applied Geology
Semester-III

GEC1: 24APG3G1L-C

Course Title: Study of Rocks and Minerals	Course code: 24APG3G1L-C
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of petrology and mineralogy.
2. Demonstrate the types of rocks and minerals.
3. Explore the minerals and rocks

GEC1: C). Study of Rocks and Minerals

Unit	Description	Hours
1	**Introduction:** Introduction: Origin of the Earth. Age of the earth. Interior of the Earth. Magma, Concepts of plate tectonics. Morphology of Oceans, Principles of Isostacy and uniformitarinism	08
2	**Petrology:** Introduction to petrology, Rock cycle, Classification of rocks: Igneous, Metamorphic and Sedimentary, types of igneous rocks, types of metamorphic rocks, types of sedimentary rocks, structure and textures of all types of rocks	09
3	**Mineralogy:** Introduction, Definition, physical prosperities of minerals, chemical properties of minerals Mineral resources, metallic minerals, non-metallic minerals, industrial minerals. Industrial applications of minerals	09

References:

1. Arthur Holmes: Physical Geology
2. Billings: Structural Geology
3. P.K. Mukerjee: General Geology
4. Strahler: Physical Geology

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Dept Name: Applied Geology
Semester-III
SEC3: 24APG3S3L

Course Title: Research Methodology	Course code: 24APG3S3L
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 01 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Discuss about the description of research problem and methods.
2. Demonstrate the research plan and design.
3. Explore the report writing skill.

SEC3: Research Methodology

Unit	Description	Hours
1	**Introduction to Research:** Nature and importance of research- Aims, Objectives and Principles: Fundamental research vs. applied research with examples: Qualitative vs Quantitative research: Theoretical research vs. experimental research with examples: Selection of a research problem and Sources of literature – Journals, Conferences, Books. Types of sources: Literature Survey engines- Scopus, web of Science, Google Scholar, PubMed, NCBI, Scihub, etc. Science citation index: Citations, h-index, i10 index, impact factor	08
2	**Methods of Data Collection:** Data Collection Methods- Framing a hypothesis, designing controlled experiments, choosing the sample-size, sampling bias, importance of independent replicates, conducting an experiment, maintaining a lab-notebook to record observations: Identifying experimental errors. Case-studies on well-designed experiments vs. poorly designed experiments. Correlations vs. Causation .Good laboratory Practices	08
3	**Data analysis (Practical):** Technical presentation, technical writing, Formatting, citations; MS Excel for plotting the data (pie chart, plots, bar charts) **Analysis using software tools:** Preparation of field geological maps, study area location maps, traversing map using GIS and CAD tools, GCD-ToolKit, Descriptive Statistics: Mean, standard deviation, variance, plotting data and understanding error-bars	10

References:

1. Qualitative Research Methods for Social Sciences by Bruce, L. B. 2001, Allyn and Bacon, Boston.
2. Computer Applications in the Social Sciences by Edward, E.B., 1990, Temple University Press, Philadelphia.
3. Survey Methodology by Robert, M. B, et al., 2009, Wiley, New Jersey.
4. Social Research Methods by Bryman, A. 2008, Oxford University Press, New York.
5. Research Design: Qualitative, Quantitative and Mixed Methods Approaches by John, W. C., 2011, Sage Publications, Thousand Oaks.
6. Power/Knowledge: Selected Interviews and Other Writings by Michel, F., edited by

Colin Gordon, 1980, Vintage, New York.
7. The Structure of Scientific Revolutions by Thomas K., 1996, University of Chicago Press, Chicago.
8. Social Research Methods: A Reader by Seale C., 2004, Routledge, London C.R. Kothari, Research Methodology: Methods and Techniques, II Ed. New Age International Publishers, (2009).
9. Shanthibhushan Mishra, Shashi Alok, Handbook of Research Methodology, I Ed, 2017, Educreation Publishers.
10. Basic Statistical Tools in Research and Data Analysis (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037948/).

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Dept Name: Applied Geology
Semester-III

DSCL: 24APG3C7P

Course Title: Exploration Geology Lab	Course code: 24APG3C7P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Evaluate the reserve estimation and ore deposit
2. Identify the groundwater potential zone

DSCL: Exploration Geology Lab

List of Experiments

1. Delineation of ore deposit based on exploration data;
2. Classification of ore reserves;
3. Economic evaluation of ore deposit;
4. Geological cross-section
5. Models of reserve estimation
6. Preparation of geochemical anomaly maps
7. Interpretation of Geochemical maps for locating ore mineralization
8. Resistivity surveys – Wenner and Schlumberger methods

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Dept Name: Applied Geology
Semester-III

DSCL: 24APG3C8P

Course Title: Hydrogeology Lab	Course code: 24APG3C8P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. Evaluate the water level and water quality
2. Identify the groundwater potential zone

DSCL: Hydrogeology Lab

List of Experiments

1. Delineation of isohyetal and thiessen polygon maps and interpreting volumes of rainfall;
2. Preparation and interpretation of water level contour maps and depth to water level maps Study;
3. Study of water potential zones of India;
4. Preparation of Iso-resisitivity maps and delineating groundwater potential zones
5. Graphical representation of chemical quality data and water classification

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Dept Name: Applied Geology
Semester-IV

DSC11: 24APG4C11L

Course Title: Advanced Geoinformatics	Course code: 24APG4C11L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the advanced geoinformatics.
2. Demonstrate the RS and GIS software tools.
3. Demonstrate the skill is to interpretation of satellite image
4. Explain the steps involved in the preparation land use and land cover maps.

DSC11: Advanced Geoinformatics

Unit	Description	Hours
1	**Introduction of Exploration:** Introduction: devices, need for high resolution data, Characteristics, specifications and applications Spectrographic imagers, hyperspectral sensors, airborne and space borne	10
2	**Spectral Remote Sensing:** Spectral characteristics of vegetation, temporal (phenological) characteristics of vegetation, vegetation index. Crop type classification concepts, spectral response of different crops. Crop diseases and assessment, advances in crop monitoring, forest change detection, forest damage assessment and forest monitoring	11
3	**Remote Sensing in Geoscience:** Remote Sensing of Soils, Remote Sensing of Rocks and Minerals; Imaging Spectroscopy of Rocks and Minerals. Geological Applications in Geomorphology; Remote Sensing in Lithology: Sedimentary, Igneous, Metamorphic – Identification of Mineral assemblages	11
4	**Urban Remote Sensing:** Remote sensing in urban and infrastructure planning: Urban/suburban resolution considerations, urban land use/land cover classification system, Residential Land use, Commercial Land use, Industrial land use, Transportation infrastructure, Communication and Utilities, transport infrastructure facilities, , methods of surveys in town planning, preparation of development plans	11
5	**Applications of Geoinformatics:** Application to groundwater / recharge studies – landslides, Mineral investigation, Petroleum exploration using GIS, GIS in mining and coastal studies	09

References:

1. John R Jensen Remote Sensing of Environment
2. Remote Sensing with special reference to agriculture and forestry, National academy of Sciences, Washintond.C., 1970, ISBN: 309-01723-8
3. Remote sensing of forest environments, concept and case studies, Kluwer academic publications, ISBN:1-4020-7405-0
4. Remote Sensing Geology, Ravi P. Gupta, Second edition, Springer, ISBN: 3-540-43185-3

5. Image interpretation in Geology, Steve Drury, Third edition, Blackwell Publications, ISBN: 0-07487-64992
6. Applied Remote Sensing for Urban planning, Governance and sustainability, M Netzband, W L Stefanov, C Redman(Eds), Springer, ISBN:978-3-540-25546-8
7. Remote Sensing and Geographic Information Systems for design and operation of Water Resources, Micheal F. Baumgartner, Gret A. Schultez and A. IvanJhonson.
8. Remote sensing and Image Interpretation, Lillesand, TM and Kiefer RW, 1987, John Wiley

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Dept Name: Applied Geology
Semester-IV

DSC12: 24APG4C12L

Course Title: Petroleum Geology	Course code: 24APG4C12L
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Discuss about the hydrocarbon deposits of India.
2. Demonstrate the Exploration and drilling techniques.
3. Demonstrate the skill is to interpretation of well logging data
4. Explain the process of hydrocarbons.

DSC12: Petroleum Geology

Unit	Description	Hours
1	**Introduction of Reservoir and Source rocks:** Composition of hydrocarbons & non hydrocarbons component; Physico-chemical properties of hydrocarbons (oil, gas, oil field waters, Coal bed methane, hydrates); Surface & subsurface occurrences of hydrocarbons; Theories of Organic & inorganic Origin of hydrocarbons: Merits & Demerits; Organic petroleum geochemistry and conversion of organic matter into hydrocarbons; Kerogen : Composition, classification and types; Source & reservoir rocks (porosity & permeability); petroliferous basins	11
2	**Petroleum Systems:** Migration-Primary & Secondary, characteristics & processes; Accumulation: Favorable & unfavorable conditions; nature of accumulation; Clastic& non clastic Reservoirs rocks; Traps: introduction, conditions of formation and Types; Introduction to Oil-Water, Gas-Oil Contacts; Fluid flow within Reservoirs	10
3	**Exploration & Logging:** Introduction to Geophysical, Geo-bio-chemical and Geobotanical prospecting. Logging: Introduction, Types & Interpretation. Seismic methods: Principles, techniques, tools and interpretation. Electrical logs: Principles, techniques, tools and interpretation. Gamma ray & neutron logs: Principles, techniques, tools and interpretation	11
4	**Development and Drilling:** Development of mature oil-gas fields: Objectives, stages, processes and execution; Enhance Oil Recovery (EOR): Primary, Secondary & Tertiary. Introduction to Drilling methods, Rigs and their types, Component of Rigs & Drilling Mechanism. Drilling and mud parameters	10
5	**Petroliferous basins:** World scenario and at least one case study of economically important; Hydrocarbon deposits; Petroliferous basins of India: Stratigraphy, lithology, structure and reserve estimation of – Bombay high, Krishna Godavari, Assam, Cambay and Jaisalmer Basins	10

References:

1. Holson, G.D. and Tiratsoo, E.N. (1985) Introduction to Petroleum Geology, Gulf Publ. Houston, Texas.
2. Leverson, A.L. (1970) Geology of Petroleum, Freeman and Company.
3. North, F.K. (1985) Petroleum Geology, Allen and Unwin.
4. Selley, R.G. (1998) Elements of Petroleum Geology, Academic Press.
5. Tissot, B.P. and Welte, D.H. (1984) Petroleum Formation and Occurrence, Springer-Verlag.

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Dept Name: Applied Geology
Semester-IV

DSE3: 24APG4E3L-A

Course Title: Mining Geology	Course code: 24APG4E3L-A
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept mining methods
2. Preparation of man power to address the mining industry
3. Demonstrate the skill to identify the suitable ore body for mining.

DSE3: A). Mining Geology

Unit	Description	Hours
1	**Introduction:** Mining terminology, classification, geological factors considered for the selection of mining method viz.- Alluvial/Surface mining, Quarrying, Opencast mining, and Underground mining methods; Geological conditions for- Types of openings, their position, shape and size -adits, inclines, shafts, levels, cross-cuts, winzes and raises. Types of drilling methods. Explosive types, composition and its applications. Surface mining machineries	10
2	**Concepts of Mining:** Introduction to Mining. Prospecting and Sampling. Trenching, Pitting, Exploratory Drilling and Calculation of Grades. Methods of Investigation of Ore Bodies. Drilling Methods and Types of Drills. Classification of Mining methods: Surface Mining, Alluvial Mining, Opencast mining or quarrying, Parts of Opencast mine: Bench Parameters, Mine Haulage. Cycles of Mining Operation, Mine Explosives	10
3	**Underground Mining:** Basic concepts and terms: Shaft, adit, winze, raise, stope, mine support and ventilation Open stope: gophering mining method, Breast stope, Open underhand stoping, Open overhand stoping, Underground glory hole, Pillar and chamber method, Sub level stoping. Supported stopes: Overhand stoping method with supports, Timbered stopes, Square set method, Filled stopes, Shrinkage stopes, Mitchell slicing system, Caving methods, Outline of underground coal mining methods, Mining machineries, Organization and structure of a mine, Role of a geologist in mining industry, Mining legislations, Preparation of mine plans, mining scheme	12
4	**Mineral prospecting and reserve estimation:** Preparation of Assay Plans/Sections - Cut off Grade, Determination of Mineable Limits. Reserves and Resource, Types and Classification, Geological / Techno economic Considerations in Reserve Classification-Reserve Estimation Methods, Surface and Underground Deposits	10
5	**Orebody modelling:** Integrating Surface / Underground mapping Drilling Sampling to evolve a 3D Model, Fold / Fault Interpretation from Maps and Bore hole Data, GIS Applications in mining and Mineral Projects	10

References:

1. Arogyaswami, R. N. P., Course in Mining Geology, Oxford and IBH Publishing house, 1980..
2. Deshmukh, R.T. (1993): High Technology in Drilling and Exploration, Oxford-IBH, New Delhi., .
3. Gupta, H.K. and Rastogi, B.K. (1976): Elements of mining Technology Dhanbad publishers., Dhanbad.
4. Parbinsingh (1991): Mining Geology, Prentice Hall, N.Y.
5. Peters, W.C. (1987): Exploration and Mining Geology, John Wiley & Sons, New York.
6. Schultz, J.R. & Cleaves, A.B. (1951): Geological methods in Mineral Exploration and Mining, Chapman & Hall, London.
7. Smirnov, U.J: Geology Of Mineral Deposits
8. Ramhor, Dr. Paul: The Ore Minerals And Their Intergrowths
9. Chugh, C.P. (1983) Manual of Drilling Technology, Oxonian Press Pvt. Ltd.
10. Chugh, C.P. (1984) Diamond Drilling, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
11. Chugh, C.P. (1992) High Technology in Drilling and Exploration, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Chugh, C.P. (1995) Drilling Technology Handbook, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
13. Clark, G.B. (1967) Elements of Mining, Asia Publishing House.
14. Lewis, R.S. (1964) Elements of Mining, John Wiley.
15. McKinstry, H.E. (1972) Mining Geology, Prentice-Hall Inc.
16. Peele, R. and Church, J.A. (1967) Handbook of mining (Vol. I and II) Wiley Eastern Ltd. New Delhi.
17. Scott, J. (1967) Mining, Mir Publishers, Moscow.
18. Shevyakov, L.S. (1957) Mining of Mineral Deposits, Foreign Languages Pubishing House, Moscow.
19. Thomas, L.J. (1978) An Introduction to Mining, Methuen, Brisbane.
20. Young, G.J. (1946) Elements of mining

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Dept Name: Applied Geology
Semester-IV

DSE3: 24APG4E3L-B

Course Title: Engineering Geology	Course code: 24APG4E3L-B
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept geo engineering methods
2. Preparation of man power to address the civil engineering applications
3. Demonstrate the skill to identify the suitable site for civil constructions.

DSE3: B). Engineering Geology

Unit	Description	Hours
1	**Introduction:** Scope of geology in civil engineering and mining industry. Various stages of engineering geological investigations for civil engineering projects. Engineering properties of rocks, rock discontinuities, physical characters of building stones, concrete and other aggregates. Use of remote sensing in engineering geology	10
2	**Geological investigations for dams & tunnels:** Geological considerations for the construction of dams and reservoir sites. Types of dams, dam foundation, rock problems. Geotechnical evaluations of tunnel alignments and transportation routes. Methods of tunneling; Classification of ground for tunneling purposes; various types of support	10
3	**Surface and subsurface geological investigation:** Geological considerations for the construction of roads/ highways and bridges. Mass Movements with special emphasis on landslide and causes of hill slope instability. Engineering consideration of seismicity, influence of geological condition on foundation and design of buildings, seismic resistant structure, earthquake problems in India	12
4	**Geological investigations for coastal development:** Coastal erosion and accretion process and its impact. Geological investigations for harbor construction, Coastal protection structures-Sea walls, bulk heads, groins, jetties	10
5	**Geotechnical studies of landslides and subsidence:** Landslide Classification, causative factors, control measures. Land subsidence, factors, causes and remedial measures. Geological considerations for monitoring of landslides. geotechnical problems related to foundation for bridge and building site investigations	10

References:

1. Krynine and Judd. Principles of Engineering Geology and Geotechnology. McGraw Hill, New York, 1962.
2. Chandler. R.J. Slope Stability and Engineering Developments 1992.
3. Waltham, T. Foundations of Engineering Geology, SPON Press, London 2002, ISBN

0-415- 25449-3.
4. Bell F G Engineering Geology, Second Edition by, 2007. Butterworth-Heinemann, Oxford
5. Sathya Narayanaswami. Engineering Geology. Dhanpat Rai and Co. 1710, Nai Sarak, Delhi- 110006.. 2000
6. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub., I Ed.,UK,1994.

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Dept Name: Applied Geology
Semester-IV
DSE3: 24APG4E3L-C

Course Title: Oil Exploration and Production	Course code: 24APG4E3L-C
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept onshore and offshore seismic survey methods
2. Preparation of man power to address the oil and gas industry
3. Demonstrate the skill to identify the suitable oil well site for production.

DSE3: C). Oil Exploration and Production

Unit	Description	Hours
1	**Seismic prospecting:** Seismic reflection prospecting, data acquisition, receiver design and characteristics, Energy source, seismic instrumentation, survey positioning, establishment of field parameters; Seismic processing, processing steps and associated pitfalls, signal migration, improving the signal, to noise ratio, velocity stacking and verification, displaying seismic data, Interpretation, structural, stratigraphy, facies, sequence and depositional environment – hot spots for oil and gas; 3 D surveying	12
2	**Drilling and Rig operation:** Types of drilling system, types of rig system, Rotary Drilling rig components, Basic operations, operational practices and procedures, Drill stem and assembly, descriptions, care, maintenance and handling practices, Drill stem Design, installation of blowout prevention	10
3	**Well logging:** Well logging, basic concepts, well bore environments, Logging Methods, Interpretation, calculation of saturation, gas saturation, water saturation porosity, permeability- finding oil, gas and water	10
4	**Casing and cementation:** Casing types, policy, specifications , forces acting, Casing design, preparation of casing to be lowered. Cementation, composition, properties, types, cementation, procedures applications	10
5	**Reservoir engineering and production:** Perforation techniques, well completion, fittings of well head, casing head housings, casing test, transportation of oil, Reservoir engineering, principles, Oil recovery, primary, secondary enhanced oil recovery techniques, chemical methods, miscible methods, thermal method. Petroleum management and economics	10

References:

1. Brian J. Evans A Hand book for seismic data acquisition in exploration. Geophysical Monograph Series Publisher:
2. Tulsa, U.S.A.(1997): Society of Exploration Geophysics,
3. Robert E. Sheriff (1980). Seismic stratigraphy, Publisher: International Human

Resources Development Corporation, Boston.
4. Bhagwan Shtay (2001): Petroleum Exploration and Exploration practices, Allied Publishers Ltd.
5. Frank John, Mark Cook &Mark Gratan (2003): Hydrocarbon exploration and production, Elsevier.
6. Drilling: The mannal of methods, application & management. Australian Drilling Industry Training Committee Ltd., Publisher : Lewis publishes, 1997.

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Dept Name: Applied Geology
Semester-IV
DSE4: 24APG4E4L-A

Course Title: Mineral Evaluation and Management	Course code: 24APG4E4L-A
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept mineral management
2. Preparation of man power to address the mineral industry
3. Demonstrate the skill to identify the suitable flow sheet for plant erection.

DSE4: A). Mineral Evaluation and Management

Unit	Description	Hours
1	**Desktop study:** Application of Geo Statistics Variogram Range, Kriging, Ore body Optimisation, Bulk Sampling, pilot Plant Saturation Prospecting, Categorisation curve, Block Recovery grade Vis-à-vis In-situ grade	10
2	**Mineral Economics:** Source of Capital Funds-Factors Governing Profitability -Time Value of Money, Evaluating Net Profit-Capital Cost Owning Cost, Operating Cost, Amortisation, Concepts of Depreciation, Cash Flow, DCF, PV, NPV Project and Loss Account, Balance sheet	11
3	**Mineral project feasibility:** Project Evaluation Techniques, Pay Back Discounted Pay Back, DCF, NPV, IRR Sensitivity Analysis WRT Grade, Price, Cut off grade, Recovery, Cost of Production, Feasibility Studies for Prospects and Operating Mines	10
4	**Mineral Processing:** Scope, Application, Brief Description of Concentrating / Processing Methods Viz Gravity, Electrostatic, Electromagnetic, Flotation, Chemical, Ion Exchange, Roasting, Smelting Mineral / Metal Recovery, Ratio of Concentration Selectivity Index-Flow Sheets of Important ore Minerals, Strategic Minerals	11
5	**Mineral policies:** Synopsis of Mineral Related Acts, Rules, Regulations - Mining Plan under MCR1961, EMP, EIA, National Mineral Policy, Mineral Conservation, PL&ML Wealth from waste, Co Products, By Products, Turnaround Strategy for Sick Mineral Based Industries from Geologists Perspective	10

References:

1. McKinstry, H.E. Mining Geology, Newyork: Prentice-Hall, Inc. 1970.
2. Deshmukh, D.J.. Elements of Mining Technology, Dhanbad: Vidyaprakshan, 1998.
3. Bruce, A.K.. Surface Mining, Colarodo: Society for Mining, Metallurgy and Exploration Inc. 1990.
4. Hustrulid, H.V and Mark Kuchta, Open Pit Mine Planning and Design Fundamentals,
5. Brookfield USA: A.A Balkema, 1995.
6. Hartman. Howard L,. Introduction to Mining Engineering, New York: John Wiley and Sons, 1987.

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Dept Name: Applied Geology
Semester-IV

DSE4: 24APG4E4L-B

Course Title: Groundwater Exploration	Course code: 24APG4E4L-B
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept groundwater exploration
2. Preparation of man power to address the quality of groundwater
3. Demonstrate the skill to identify the suitable potential zone of groundwater.

DSE4: B). Groundwater Exploration

Unit	Description	Hours
1	**Introduction:** Hydrological cycle, geological formations as aquifers, aquifer parameters, their estimation, groundwater flow and recharge, Sink holes, natural compaction, groundwater problems in mines and slopes, environmental impacts related to groundwater exploration	10
2	**Occurrence and distribution of Groundwater:** Vertical distribution of groundwater. Hydrologic properties of Rocks – Porosity, Hydraulic conductivity, Derivation and validation of Darcy's Law. Aquifers, Characteristics of unconfined and confined aquifers, Behaviour of alluvium, sedimentary, crystalline and volcanic rocks as aquifers, Flow net analysis, Types of well	11
3	**Exploration techniques:** Integrated approach to groundwater prospecting: Role of toposheets and remote sensing in groundwater exploration, Hydrogeomorphological mapping, Surface and subsurface Geophysical methods, Tracer techniques Exploratory Borewell programme	10
4	**Groundwater quality and pumping test:** Quality of groundwater, chemical standards for drinking and irrigational water- concept of hydrogeochemicalfacies, Seawater intrusion – Ghyben Herzberg relation remedial measures. Pumping tests principles, types of pumping tests, procedures, determination of aquifer properties and well characteristics by simple graphical methods. Significance of transmissivity, storativity and specific capacity of wells	11
5	**Groundwater protection:** Groundwater contamination, methods of assessment, application of groundwater modeling, damage prevention, remediation of aquifers, bio remediation of contaminated aquifers	10

References:

1. Soliman, M.M et al . Environmental Hydrogeology, Lewis Publ., 1997
2. Freeze, R.A and Cherry, J.A Groundwater, Prentice Hall, 1979

3. Coates,D.R. Environmental Geology, John Wiley, 1981
4. Keller, E.A, Environmental Geology, Columbus, 1985
5. Marcel van der Perk, Soil and Water Contamination: From Molecular to Catchment, Scale, Taylor and Francis, 2006
6. Appelo, C.A.J. and D. Postma, Geochemistry, Groundwater and Pollution, Taylor & Francis; 2 edition,, 2005

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Dept Name: Applied Geology
Semester-IV
DSE4: 24APG4E4L-C

Course Title: Industrial Geology	Course code: 24APG4E4L-C
Total Contact Hours: 04 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

1. Describe the concept mineral project evaluation
2. Preparation of man power to address the mineral conservation
3. Demonstrate the skill to identify the suitable mineral policies for mines

DSE4: C). Industrial Geology

Unit	Description	Hours
1	**Economics in mineral exploration:** Economic Considerations in Mineral Exploration; Systematic approach to Exploration Expenditure; In-situ and Mineable Reserves; Pit Optimization; Bulk Sampling; Pilot Plant Studies; Demand and Price Projections	11
2	**Mineral / Mine economics and finance:** Source of Mine Finance; Factors governing profitability; Concepts of Depreciation, Depletion, Present value, Cash Flow and DCF; Costs-Capital, Fixed / variable, Ownership; P & L Account; Balance Sheet	10
3	**Mineral project evaluation:** Time Value of Money; Project Evaluation Technique-Pay Back, Discounted Pay Back, DCF, IRR; Project Ranking; Sensitivity analysis; Feasibility study-Prospect and Operating Mines; Preparation of Mine Plan under Mineral Concession Rules	11
4	**Mineral conservation:** Growth of the awareness; Means of conservation; Limitations in Scope; Wealth from Mineral waste; Co-products and By-products; Substitute for Minerals	10
5	**Mineral policies and environment:** National Mineral Policy; Prospecting License and Mining Lease; Mines Act, CMR, MMR, Mines Rules, MMRD Act and Rules, EMP, EIA	10

References:

1. Gentry, D.W & O'Neill J.O 1984. Mine Investment Analysis, New York: Society of Mining
2. Engineers of American Institute of Mining, Metallurgical and Petroleum Engineers.
3. Ian Runge, C. 1998 Mining Economics and Strategy, Littleton USA: Society of Mining, Metallurgy and Exploration, Inc.
4. Chatterjee, Kaulir Kishore, 2003, Introduction to Mineral Economics, Chennai, Wiley Eastern Limited and Lakshmi Publications.
5. Bruce, A.K. 1990 Surface Mining, Colorado, Society for Mining, Metallurgy and Exploration, Inc. Published Mines/Minerals Legislations
6. Ghosh A.K. & Bose, L.K. 2003, Mining in the 21st Century, New Delhi, Oxford & IBH Published Company Pvt Limited.

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Dept Name: Applied Geology
Semester-IV
GEC2: 24APG4G2L-A

Course Title: Water Resource Management	Course code: 24APG4G2L-A
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of water resource management system.
2. Demonstrate the water resources in India.
3. Explore the conservation of water resources.

GEC2: A). Water Resource Management

Unit	Description	Hours
1	**Introduction:** Introduction to hydrogeological cycle, world water budget, surface water, subsurface water, river system, Controls of geology on groundwater occurrence, movement and distribution; Classification of aquifers and aquifer systems; Mode of occurrence of groundwater in different geological formations and groundwater provinces of India	08
2	**Planning and Development:** Surface and subsurface methods of groundwater exploration; Application of remote sensing in groundwater exploration; Collection of hydrogeological data and preparation of hydrographs; Selection of suitable site for well construction; Type and design of wells, methods of well construction, well completion and well development	08
3	**Water conservation and management:** Artificial recharge to groundwater and rainwater harvesting; Management of groundwater resources; Conjunctive use of groundwater and surface water; Concept of watershed: Watershed characters, importance of water resources; Technical aspects of artificial recharge structures	10

References:

1. K. Subramanya, Engineering Hydrology, Tata McGraw Hill Publishers, New Delhi.
2. H.M. Raghunath, Ground Water, Wiley Eastern Publication, New Delhi.
3. Daniel P. Loucks and Eelco van Beek, Water Resources Systems. Planning and Management, UNESCO Publication.
4. Mollinga, P. et al, Integrated Water Resources Management, Water in South Asia Volume I, Sage Publications, 2006.
5. Singh, Chhatrapati Water Rights in India, Ed: Chhatrapati Singh. Water Law in India: The Indian Law Institute, New Delhi,1992.
6. Dhruva Narayana, G. Sastry, V. S. Patnaik, Watershed Management, CSWCTRI, Dehradun, ICAR Publications, 1997.
7. Lal, Ruttan.Integrated Watershed Management in the Global Ecosystem. CRC Press, New York.
8. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York

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Dept Name: Applied Geology
Semester-IV
GEC2: 24APG4G2L-B

Course Title: Remote Sensing and GIS	Course code: 24APG4G2L-B
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of RS and GIS.
2. Demonstrate the Remotes Sensing techniques.
3. Explore the RS and GIS tools.

GEC2: B). Remote Sensing and GIS

Unit	Description	Hours
1	**Introduction:** Introduction: History and Development of Remote Sensing, Fundamental Principles of Remote Sensing- Stages in Remote Sensing Process. Types of Remote Sensing- Advantages of Remote sensing, Aerial Photographs, Basics, Photo Mosaics and Photo scale. Electro Magnetic Radiation (EMR): EMR Spectrum – EMR Interaction with Atmosphere	10
2	**Satellite Remote Sensing:** Orbit and Sun-synchronous aspect of satellite; Remote Sensing Sensor: Platforms and sensor resolution and calibration aspects of remotely sensed data, microwave sensor and False Colour Composite (FCC); Fundamentals of digital image processing: Image rectification, Image enhancement and Image classification; Space research in India: Bhaskara, IRS series and their applications	08
3	**GIS:** Introduction to GIS. Principles and components of GIS; Geospatial data, data for GIS application, spatial data models and data structures; Vector and raster based GIS; Spatial data acquisition, Vector overlay analysis; Terrain analysis (DEM); Introduction to GIS and remote sensing software; Geological applications of GIS; Principle and application of GPS	08

References:

1. D.R.Lueder. Aerial photographic interpretation, Principles and applications. McGraw-Hill New York. (1959)
2. Anji Reddy, M. (2012) Textbook of Remote Sensing & GIS, BS Publications,Hyderabad
3. Photogeology - Miller, J.C.
4. Berhardsen, T. (1999) Geographic Information System: an introduction, Wiley, New York.
5. Bonham-Carter, G.F. (1994) Geographic Information System for Geoscientists: Modelling with GIS, Pergamon.
6. Burrough, P.A. (1986) Principles of Geographical Information Systems for land resources assessment, Clarendon Press, Oxford.

7. Burrough, P.P. and MacDonnel, R.A. (1998) Principles of GIS, Oxford University Press.
8. Curran, P.J. (1985) Principles of Remote Sensing, Longman Scientific & Tech. Group, Essex, England.
9. Drury, S.A. (2001) Image Interpretation in Geology, Chapman and Hall, London.
10. Gupta, R.P. (1991) Remote Sensing Geology, Springer-Verlag.
11. Jain, A.K. (1989) Fundamentals of digital image processing, Prentice Hall India.
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13. Lattman, L.H. and Ray, R.G. (1965) Aerial photographs in field geology, McGraw Hill.
14. Pande, S.N. (1987) Principles and Applications of Photogeology, Wiley Eastern Limited.
15. Lillesand, T.M. and Kiefer, R.W. (2000) Remote Sensing and Image Interpretation, John Wiley and Sons Inc., New York.
16. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (1991) GIS - Principles and Applications, Longman Scientific and Technical.
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18. Miller, V.C. (1961) Phologeology, McGraw Hill.
19. Paine, D.P. (1981) Aerial photography and Image Interpretation for Resource Management, John Wiley.
20. Ray, R.G. (1969) Aeriat Photographs in Geologic Interpretations, USGS Proc Paper 373.
21. Richards, J.A. (1986) Remote Sensing Digital Analysis: an introduction, Springer-Verlag, Berlin.
22. Sabins, F.F. Jr. (2000) Remote Sensing Principles and Interpretations, W.H. Freeman & Company, USA
23. Siegal, B.S. and Gillespie, A.R. (1980) Remote Sensing in Geology, John Wiley

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Dept Name: Applied Geology
Semester-IV

GEC2: 24APG4G2L-C

Course Title: Mining and Society	Course code: 24APG4G2L-C
Total Contact Hours: 02 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 02 Hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

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

1. Discuss about the description of mining activities.
2. Demonstrate the working principle of mines.
3. Explore the social responsibility of mines.

GEC2: C). Mining and Society

Unit	Description	Hours
1	**Introduction:** Introduction to Sustainable development for mining sector: Environmental and social perception about mining, Impact of mining on the environment, Definition of sustainable development in mining and need for sustainable development in mining, Overview of sustainable development framework for mining and principles of sustainable development framework Legal and institutional framework	08
2	**Mining:** Introduction to Mining and civilization, History of mining; Types of mining methods; Mining in everyday life, Mining to protect Health and save lives; Responsible mining Concept: corporate social responsibility, making responsible mining happen	08
3	**Society:** Gains and Losses at the Local Level, An Economic Perspective, A Social Perspective, A Cultural and Political Perspective; An Environmental Perspective; Maximizing Mining's Contribution to Communities; Revenue Distribution and Use, Gender Disparities, Projects, Funds, and Foundations, Supporting Small Local Businesses, Employment and Skills Development, Retrenchment, Conflict and Dispute Resolution, Community Health Initiatives, Community Participation in Decision-making, Improved Social Impact Assessment	10

References:

1. Sustainable mining in India – Overview of legal and regulatory framework, technologies and best process practices – Indian Chamber of Commerce and Cuts – Centre for International Trade, Economics and Environment, 2018.
2. SME Mining Engineering Hand Book (Third Edition) – Peter Darling

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Dept Name: Applied Geology
Semester-IV

DSCL: 24APG4C9P

Course Title: Advanced Geoinformatics Lab	Course code: 24APG4C9P
Total Contact Hours: 04 / week	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

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

1. To know the downloading of high resolution satellite images
2. Demonstrate the skill is on QGIS and Google Earth Maps
3. To know the preparation of lithology, LU-LC and Soil maps using QGIS and Satellite images

DSCL: Advanced Geoinformatics Lab

List of Experiments

1. Downloading the high resolution satellite images form open source data
2. Working principle of QGIS and Google Earth Maps;
3. Data extraction from the satellite images and Google Earth Maps;
4. Preparation of Land use and land cover map;
5. Preparation of lithology map
6. Preparation of the contour map
7. Preparation of the soil map
8. Preparation of the Slope map
9. Preparation of layout map design for presentations

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Dept Name: Applied Geology
Semester-IV

Research Project Work: 24APG4C1R

Course Title: Research Project Work	Course code: 24APG4C1R
Total Contact Hours: 08 / week	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 04 Hours
Summative Assessment Marks: 70	

Course Learning Objective:
The students are allowed to work in various domains of geology and make them collect, process, analyze and interpret the data to bring out new results

NOTE:
The candidate should submit an independent hard bond form of research project report by the end of final year course on a topic relevant to Earth Science, based on the laboratory experiments / case studies / field studies carried out in a Geoscience / Mining / Industry, it will be evaluated by external and internal examiners. It will be carried out IV semester, but will be started in the III semester. Three copies of the research project report shall be submitted to the Project Guide, Department of Applied Geology before 15 Days of the examination of fourth semester

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