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

Department of Studies in

APPLIED GEOLOGY

Master of Science
(IV Semester)

With effect from
2021-22

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

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	21APG4C11L	Advanced Geoinformatics	30	70	100	4	-	-	4	3
	DSC12	21APG4C12L	Petroleum Geology	30	70	100	4	-	-	4	3
	DSE3	21APG4E3L	A. Mining Geology B. Engineering Geology C. Oil Exploration and Production	30	70	100	4	-	-	4	3
	DSE4	21APG4E4L	A. Mineral Evaluation and Management B. Groundwater Exploration C. Industrial Geology	30	70	100	4	-	-	4	3
	GEC2	21APG4G2L	A. Water Resource Management B. Remote Sensing and GIS C. Mining and Society	20	30	50	2	-	-	2	1
	DSCL	21APG4C9P	Advanced Geoinformatics Lab	20	30	50	-	-	4	2	4
	Project	21APG4C1R	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.

Dept Name: Applied Geology
Semester-IV

DSC11: 21APG4C11L

Course Title: Advanced Geoinformatics	Course code: 21APG4C11L
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

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-IV

DSC12: 21APG4C12L

Course Title: Petroleum Geology	Course code: 21APG4C12L
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: 21APG4E3L-A

Course Title: Mining Geology	Course code: 21APG4E3L-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: 21APG4E3L-B

Course Title: Engineering Geology	Course code: 21APG4E3L-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: 21APG4E3L-C

Course Title: Oil Exploration and Production	Course code: 21APG4E3L-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: 21APG4E4L-A

Course Title: Mineral Evaluation and Management	Course code: 21APG4E4L-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: 21APG4E4L-B

Course Title: Groundwater Exploration	Course code: 21APG4E4L-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: 21APG4E4L-C

Course Title: Industrial Geology	Course code: 21APG4E4L-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: 21APG4G2L-A

Course Title: Water Resource Management	Course code: 21APG4G2L-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: 21APG4G2L-B

Course Title: Remote Sensing and GIS	Course code: 21APG4G2L-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.
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Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-IV

GEC2: 21APG4G2L-C

Course Title: Mining and Society	Course code: 21APG4G2L-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

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-IV

DSCL: 21APG4C9P

Course Title: Advanced Geoinformatics Lab	Course code: 21APG4C9P
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

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-IV

Research Project: 21APG4C1R

Course Title: Advanced Geoinformatics Lab	Course code: 21APG4C1R
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

Date Course Coordinator Subject Committee Chairperson