VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

APPLIED GEOLOGY

SYLLABUS

Master of Science
(II Semester)

With effect from
2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Applied Geology

Jnana Sagara, Ballari - 583105

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

II – SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
SECOND	DSC5	21APG2C5L	Igneous Petrology	30	70	100	4	-	-	4	3
	DSC6	21APG2C6L	Metamorphic Petrology	30	70	100	4	-	-	4	3
	DSC7	21APG2C7L	Sedimentary Petrology	30	70	100	4	-	-	4	3
	DSC8	21APG2C8L	Applied Ore Geology	30	70	100	4	-	-	4	3
	SEC2	21APG2S2LP	Digital Image Processing	20	30	50	1	-	2	2	1
	DSC5P4	21APG2C4P	Igneous and Metamorphic Petrology Lab	20	30	50	-	-	4	2	4
	DSC7P5	21APG2C5P	Sedimentary Petrology Lab	20	30	50	-	-	4	2	4
	DSC8P6	21APG2C6P	Applied Ore Geology Lab	20	30	50	-	-	4	2	4
Total Marks for II Semester						**600**				**24**	

Dept Name: Applied Geology
Semester-II
DSC5: IGNEOUS PETROLOGY

Course Title: Igneous Petrology	Course code: 21APG2C5L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3
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.	10
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	11

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

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-II
DSC6: METAMORPHIC PETROLOGY

Course Title: Metamorphic Petrology	Course code: 21APG2C6L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3
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
   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 5olitic, 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. Barker A.J. Introduction to Metamorphic Textures and Microstructures. 1st ed., Blackie, Glasgow; 2nd ed., Stanley Thornes, Cheltenham, 1998.
9. Best M.G., Igneous and Metamorphic Petrology, 2nd ed. Blackwell. UK, 2002

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-II
DSC7: SEDIMENTARY PETROLOGY

Course Title: Sedimentary Petrology	Course code: 21APG2C7L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3
Summative Assessment Marks: 70	

Course Outcomes (CO's):

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

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

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	11
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	10
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

Date Course Coordinator Subject Committee Chairperson

Dept Name: Applied Geology
Semester-II
DSC8: APPLIED ORE GEOLOGY

Course Title: Applied Ore Geology	Course code: 21APG2C8L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3
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	11
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 – Refractory Materials – Abrasive Minerals – Fertilizer Minerals and Gemstones	10
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.

Date Course Coordinator Subject Committee Chairperson

SEC 2: DIGITAL IMAGE PROCESSING

Course Title: Digital Image Processing	Course code: 21APG2S2LP
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1
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

SEC 2: 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 (indicative)

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)

Dept Name: Applied Geology
Semester-II
DSC5P4: IGNEOUS AND METAMORPHIC PETROLOGY LAB

Course Title: Igneous and Metamorphic Petrology Lab	Course code: 21APG2C4P
Formative Assessment Marks: 20	Course Credits: 02
Summative Assessment Marks: 30	Duration of ESA/Exam: 4

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.

DSC5P4: IGNEOUS AND METAMORPHIC PETROLOGY LAB

Sl. No.	Experiments
Igneous petrography Experiments	
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 Experiments	
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

Dept Name: Applied Geology
Semester-II
DSC7P5: SEDIMENTARY PETROLOGY LAB

Course Title: Sedimentary Petrology Lab	Course code: 21APG2C5P
Formative Assessment Marks: 20	Course Credits: 02
Summative Assessment Marks: 30	Duration of ESA/Exam: 4

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.

DSC7P5: SEDIMENTARY PETROLOGY LAB

Sl. No.	Experiments
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.