VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Mineral Processing

Programme: Master of Science (M.Sc.)/ Master of Technology (M.Tech) in Mineral Processing

Duration: 2 Years (4 semesters)

Programme Overview:

Master of Science (M.Sc.)/ Master of Technology (M.Tech) in Mineral processing programme is designed to prepare students for a career in Mineral and Metallurgical Research and related Industry by introducing them to a concepts in Mineral Processing. The programme aims to provide basic understanding of principles, concepts and field based knowledge of Mineral Processing through well-structured curriculum and experimentation to understand the mineral and metallurgical industrial challenges.

Programme Educational Objectives (PEOs):

After 3-4 years of completion of the programme, the graduates will be able to:

1. Hold positions in mineral-based academic, research institutions, and industry.
2. Design various circuit configurations for processing low-grade ferrous and non-ferrous ores.
3. Implement ecological and environmental friendly processes for mineral industry to achieve sustainable growth.
4. Execute professional leadership and organizational goals towards conservation of mineral resources.

Programme Outcomes (POs):

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

1. Identify the minerals and their end applications in industry
2. Formulate a separation system, or process to meet the desired needs of Metallurgical engineers within economic, Environmental and social constraints
3. Demonstrate separation of sizing, classification, Minerals and separation of valuable minerals from gangue in the ores by various mineral processing methods etc.
4. To collaborate with multidisciplinary sciences and its application to mineral engineering
5. Identify and formulate the scheme to solve technical problems in mineral based plants
6. Demonstrate Sizing, Classification, Separation of minerals from one another and from gangue in the ore by various mineral processing methods
7. Recognize the need of conservation of mineral reserves and development of safe and zero waste technology in global environment.
8. 8. Use the techniques, skills, and modern engineering tools necessary for mineral engineering practices.
9. Understand engineering and management principles and its application through post rational approaches for the extraction of minerals and metals.
10. Understand professional responsibility and skill.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Distribution of Courses/Papers in Postgraduate Programme I Semester as per Choice Based Credit System (CBCS)

Mineral Processing

M.Sc./M.Tech I - SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem Exam	Total	L	T	P		
FIRST	DSC1	21MNP1C1L	Mineralogy	30	70	100	4	-	-	4	3
	DSC2	2 1MNP1C2L	Petrology	30	70	100	4	-	-	4	3
	DSC3	21MNP1C3L	Analysis of Ores and Minerals	30	70	100	4	-	-	4	3
	DSC4	21MNP1C4L	Applied Mathematics and Experimental Design	30	70	100	4	-	-	4	3
	SEC1	21MNP1S1LT	Furnaces and Refractory	20	30	50	1	1	-	2	2
	DSC1P1	21MNP1C1P	Mineralogy Lab	20	30	50	-	-	4	2	4
	DSC2P2	21MNP1C2P	Petrology Lab	20	30	50	-	-	4	2	4
	DSC3P3	21MNP1C3P	Analysis of Ores and Mineral Lab	20	30	50	-	-	4	2	4
Total Marks						**600**				**24**	

M.Sc/M.Tech(Mineral Processing) 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	21MNP2C5L	Ore Genesis and Ore Microscopy	30	70	100	4	-	-	4	3
	DSC6	21MNP2C6L	Comminution and Sizing	30	70	100	4	-	-	4	3
	DSC7	21MNP2C7L	Ore Classification and Gravity Separation Processes	30	70	100	4	-	-	4	3
	DSC8	21MNP2C8L	Indian Mineral Deposits	30	70	100	4	-	-	4	3
	SEC2	21MNP2S2LT	Computational Techniques in Mineral Processing	20	30	50	1	2	-	2	2
	DSC5P	21MNP2C5P	Ore Microscopy Lab	20	30	50	-	-	4	2	4
	DSC6P	21MNP2C6P	Comminution and Sizing Lab	20	30	50	-	-	4	2	4
	DSC7P	21MNP2C7P	Ore Classification and Gravity Separation Processes Lab	20	30	50	-	-	4	2	4
	Total Marks					**600**				**24**	

M.Sc/M.Tech(Mineral Processing) III-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem Exam	Total	L	T	P		
Third	DSC9	21MNP3C9L	Magnetic and Electrostatic Separation Technology	30	70	100	4	-	-	4	3
	DSC10	21MNP3C10L	Froth Flotation	30	70	100	4	-	-	4	3
	DSE1	21MNP3E1AL	A. Non Ferrous Extractive Metallurgy	30	70	100	4	-	-	4	3
		21MNP3E1BL	B. Elements of Mining Technology								
		21MNP3E1CL	C. Heat and Mass Transfer								
	DSE2	21MNP3E2AL	A. Surface Chemistry	30	70	100	4	-	-	4	3
		21MNP3E2BL	B. Bio Processing								
		21MNP3E2CL	C. Dynamics of Machine								
	GEC1	21MNP3G1AL	A. Basic Techniques of Mineral Dressing	20	30	50	2	-	-	2	2
		21MNP3G1BL	B. Principles of Iron Making								
		21MNP3G1CL	C. Environmental Management								
	SEC3	21MNP3S3LP	Research Methodology	20	30	50	1	-	2	2	2
	DSC9P	21MNP3C9P	Magnetic and Electrostatic Separation Technology Lab	20	30	50	-	-	4	2	4
	DSC10P	21MNP3C10P	Froth Flotation Lab	20	30	50	-	-	4	2	4
	Total Marks					**600**				**24**	

M.Sc/M.Tech(Mineral Processing) IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem Exam	Total	L	T	P		
Fourth	DSC11	21MNP4C11L	Mineral Processing Plant Design	30	70	100	4	-	-	4	3
	DSC12	21MNP4C12L	Ferrous extractive Metallurgy	30	70	100	4	-	-	4	3
	DSE3	21MNP4E3AL	A. Cement Technology	30	70	100	4	-	-	4	3
		21MNP4E3BL	B. Industrial Engineering and Management								
		21MNP4E3CL	C. Pollution control and Eco-System Management								
	DSE4	21MNP4E4AL	A. Dewatering and Tailing Management	30	70	100	4	-	-	4	3
		21MNP4E4BL	B. Advanced Foundry Technology								
		21MNP4E4CL	C. Mineral Engineering Economics								
	GEC2	21MNP4G2AL	A. Indian Mineral Resources	20	30	50	1		2	2	2
		21MNP4G2BL	B. Fundamentals of Computer and Office Automation								
		21MNP4G2CL	C. Waste Recycling								
	DSC11P	21MNP4C11P	Metallurgy Lab	20	30	50	-	-	4	2	4
	Project	21MNP4C1R1	Project	30	70	100			8	4	4
	Total Marks					**600**				**24**	

M.Tech(Mineral Processing) V-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
Fifth	DSC13	21MNP5C13L	Coal Preparation and Fuel Technology	30	70	100	4	-	-	4	3
	DSC14	21MNP5C14L	Agglomeration Techniques	30	70	100	4	-	-	4	3
	DSC15	21MNP5C15L	Process Control and Automation	30	70	100	4	-	-	4	3
	DSC16	21MNP5C16L	Modelling and Simulation of Mineral ProcessingUnit Operations	30	70	100	4	-	-	4	3
	SEC4	21MNP5S4P	VISIT to Mineral/ Metallurgical Plants	20	30	50	-	-	4	2	2
	DSC13P	21MNP5C13P	Coal Preparation and Fuel Technology Lab	20	30	50	-	-	4	2	4
	DSC14P	21MNP5C14P	Agglomeration Lab	20	30	50	-	-	4	2	4
	DSC16P	21MNP5C16P	Modelling and Simulation Lab	20	30	50	-		4	2	4
	Total Marks				**600**				**24**		

M.Tech (Mineral Processing) VI-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks		Toatl Credits
				Sem. Exam	Total	
Sixth	Project	21MNP6R2	Project Report and Viva - Voce	250	250	10
		21MNP6IT	Industrial Training report	50	50	2
	Total Marks				**300**	**12**

(I-VI semester)- Total Marks: 3300 Total credits: 132

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.

M.Sc./M.Tech (Mineral Processing) First Semester

Course: Mineralogy	Course Code: 21MNP1C1L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. To Identify and study the properties of different minerals both in hand Specimen and under the microscope.
2. To Prepare the mineral sample for microscopic studies.

UNIT – I **11 Hours**

Introduction, Elements of Crystals, Crystal morphology, Euler's formula. Goniometry: Interfacial angle, law of constancy of interfacial angles, Contact and Optical Goniometers. Symmetry characters– Plane of Symmetry, Axis of Symmetry and Centre of Symmetry. Crystallographic Axes, Parameters and Indices, Weiss and Muller's Notations. Classification of Crystals into six systems. Crystal.Forms: Simple, Open, Combination and Closed forms. Holohedrons, Hemihedrons, Tetrahedrons and Hemi morphs. Study of crystals of Normal classes. Twins: Definition, characters and types. A brief introduction to X-ray crystallography.

UNIT-II **09 Hours**

Definition of Mineral, crystalline and amorphous states, Crystalline aggregates – Columnar, Bladed, Acicular, Fibrous, Tabular, Foliated, Granular and Imitative forms. Properties depending upon light: Colour Pleochroism. Play of colours, Opalescence, Fluorescence, Phosphorescence, Streak, Luster and Diaphaneity.

UNIT-III **10 Hours**

Properties depending upon cohesion and elasticity: Cleavage, Fracture, Hardness and Tenacity. Properties depending upon electricity: Electrical conductivity, Frictional and thermoelectricity, Pyroelectricity and Piezoelectricity. Properties depending upon Heat and Magnetism: Fusibility, Thermal conductivity, Specific heat, Para and Diamagnetism. Determination of specific gravity by balance, Pychnometer, Jolly's spring balance, Walker's steel yard and Heavy liquids. Solid solution, interstitial and defect solid solution. Isomorphism, Polymorphism and Pseudomorphism.

UNIT- IV **11 Hours**

Classification of silicate structures: Brief study of feldspars, olivine, garnet, pyroxene, amphiboles, mica and silica group of minerals. Description of non- silicate group of minerals: Native elements, Carbonates, Oxides and Hydroxides , Sulfates and Sulfosalts.

UNIT – V **11 Hours**

Optical Mineralogy: Preparation of thin sections of minerals and rocks. Petrological microscope: Its mechanical and optical parts. Nicol prism and its construction. Accessory plates – construction and use of Quartz wedge, Gypsum and Mica plates.Microscopic examination of minerals under plane polarized and crossed nicols-Colour, Pleochroism, Relief, Isotropism and Anisotropism, Interference colors, Birefringence, Extinction (causes and types only), and Optic sign (Types and determinations only).

References:

1. H.H. Read - Rutley's Elements of Mineralogy
2. M.H.Battey - Mineralogy For students
3. E.S.Dana & W.E.Ford - A Text Book of Mineralogy
4. C.S.Hurlbut Dana's - Manual of Mineralogy.
5. William E. Ford Dana's - Textbook of Mineralogy
6. Pramod O Alexander - A Hand Book of Minerals, Crystals, Rocks and Ores
7. C. Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2009
8. Maureen M. Julian, Foundations of Crystallography, Taylor & Francis Group (2008)
9. W. A. Deer (Editor), R. A. Howie (Editor), J. Zussman (Editor) - Introduction to the Rock-forming Minerals Paperback –2013
10. Klein, C and Hurlbut, Jr., C.S. 1993; Manual of Mineralogy. John Wiley.
11. Krauskopf, K. B. and D. K. Bird. 1995. Introduction to Geochemistry. New York: McGraw-Hill.
12. William M. White, Geochemistry, 2013, Wiley-Blackwell

Course Out Come : After completion of this course, students will be able to

CO	Statement
CO1	To identify and differentiate the minerals based on appearance and their properties.
CO2	Suggest the application of Minerals for different end uses
CO3	Appreciate the mineral property by identifying its application useful to mineral separation

M.Sc./M.Tech (Mineral Processing) First Semester

Course: PETROLOGY	**Course Code: 21MNP1C2L**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. To Identify and study the different minerals present in the rocks both in hand specimen and thin sections of the rocks under the microscope.

UNIT – I : 12 Hours

Introduction : The Origin of Planets, Early Earth and Formation of a Layered Planet, Earth as a System of Interacting Components, Earth Through Geologic Time. Concept of heat and temperature inside the Earth. Melting and crystallization. Magma and magmatic processes. Concept of intrusion and extrusion.

UNIT-II : 09Hours

Igneous Petrology : Forms and types of igneous bodies:- extrusive bodies- Flood basalts, Volcanoes and types of volcanoes. Pyroclastic deposits. Intrusive bodies:- concept of concordant and discordant intrusion, Dikes and sills and types of dikes, breccia pipes, Laccoliths, Lopoliths, Stocks and Batholiths.

UNIT-III : 09Hours

Structure and textures of igneous rocks. Classification of igneous rocks- concept of mode and norm. Phase rule and concept of phase diagrams. Mineralogical and chemical description and significance of important igneous rocks of continental and oceanic association

UNIT- IV : 11 Hours

Metamorphic Petrology: Concept of metamorphism- Changes in pressure and temperature. Equilibrium and non-equilibrium reactions. Agents of metamorphism. Types of metamorphism, metamorphic grade and facies of metamorphism. Texture, structure and classification of metamorphic rocks. Pressure-temperature composition diagrams for paragenitic studies. Metamorphism and deformation.

UNIT – V : 11 Hours

Sedimentary Petrology : Introduction to the Processes and factors influencing genesis of sediments.Weathering, soil formation, erosion and transport of debris and their deposition and conversion to rocks. Sedimentary structure and texture for petrography of clastic and non-clastic Rocks. Methods of description and classification of sediments and sedimentary rocks: Siliciclastic, Carbonate, and Chemical deposits and brief introduction to their origin. Depositional environment of sedimentary rocks, Burial and lithification

Reference Books:

1. Frank Press Raymond Siever: Understanding Earth (3rd ed). W.H. Freeman and Company. New York . 2000
2. B. J. Skinner and S.C. Porter: The Dynamic Earth – An Introduction to Physical Geology 3rd edition. John Wiley & Sons, New York. 1995.
3. Best, M.G., 2002, Igneous and metamorphic petrology, 2nd Edition, Blackwell Publishers
4. Philpots A.R., 1990, Principles of Igneous and metamorphic petrology, Prentice Hall
5. Yardley, B.W., 1989, An introduction to metamorphic petrology, Longman
6. Sengupta, S.M. (1994) Introduction to Sedimentology, Oxford & IBH
7. Tucker, M.E. (1981) Sedimentary Petrology: an introduction. John Willey & Sons, New York
8. Blatt, Middleton & Murray (1980) Origin of sedimentary rocks. Printice Hall Inc
9. Pettijohn, F.J. (1975) Sedimentary rocks. Harper and Row Publ., New Delhi
10. Prothero, D.R., Schwab, F., (2003) Sedimentary Geology. W. H. Freeman; 2nd edition

Course Outcome : After completion of this course, students will be able to

CO	Statement
CO1	Identify and know the essential and accessory minerals present in the rocks.
CO2	Explain the process involved in the formation of different types of rocks.
CO3	Appreciate different texture and structures present in rocks.
CO4	Recommond the rocks for different purposes depending upon the properties possessed.

M.Sc./M.Tech (Mineral Processing) First Semester

Course: ANALYSIS OF ORES AND MINERALS	Course Code: 21MNP1C3L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:
This course is designed to understand the methods of estimation of metal content in the feed and products produced by various mineral separation processes

UNIT – I 11 Hours

Introduction, Sampling, Common apparatus and techniques, Accuracy and Precision. Separation techniques: Solvent extraction, Ion-exchange and brief idea about Chromatography

UNIT-II 09 Hours

Titrimetric Analysis: Theory and classification. Redox and Complexometric titrations. Gravimetry: Theory-methods-super saturation co-precipitation and post-precipitation. Precipitation from homogeneous solutions, Washing, drying and Ignition of the precipitate.

UNIT-III 09 Hours

Electrogravimetry: Principles and applications in the electrolytic separation of metals. Fire Assaying: Analysis of Gold and Silver. Proximate analysis of solid, liquid and gaseous fuels

UNIT- IV 11 Hours

Spectral Methods of Analysis: Principles, Instrumentation and application of Colorimetry and Spectro photometry, Flame photometry, Atomic Absorption Spectrometry and Flame emission spectroscopy

UNIT- V 13 Hours

Thermal Analysis: Thermo Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA). A brief review of Electron Spectroscopy for Chemical Analysis (ESCA), X-ray diffraction, Electron Microprobe Analyser, (EMPA), X-ray Fluorescence and Inductively Coupled Plasma (ICP). Analysis of common ores like – Haematite, Pyrolusite, Magnetite, Chromite, Dolomite, Limestone, Bauxite, Magnesite, Chalcopyrite, Sphalerite, Baryte and Graphite.

Reference books:

1. Chatwal & Anand - Instrumental Methods of Chemical Analysis
2. G.W. Ewing - Instrumental Methods of Chemical Analysis
3. B.K.Sharma - Instrumental Methods of Chemical Analysis
4. P.J.Potts - A Hand book of Silicate Rock Analysis
5. F.J.Welcher - Standard Methods of Chemical Analysis
6. N.H.Furman - Standard Methods of Chemical Analysis
7. A.I.Vogel - Text Book of Quantitative Inorganic Analysis
8. Jain & Agarwal - Metallurgical Analysis

Course Outcome: After completion of this course, students will be able to

CO	Statement
CO1	Perform the Chemical analysis of the ore sample and products.
CO2	Analyse the ore products for precious metals.
CO3	Do the characterization of the products obtained by mineral processing operations
CO4	Estimate the errors in results and quantify the results with standards
CO5	Use different equipments for characterization

M.Sc./M.Tech (Mineral Processing) First Semester

Course: APPLIED MATHEMATICS AND EXPERIMENTAL DESIGN	Course Code: 21MNP1C4L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objective:

1. This course is focused to develop the mathematical calculations and the statistical analysis ability for optimization of processes and to enhance the equipment performance.

UNIT – I 09 Hours

Equations: Linear equations of first degree, quadratic equations, solutions by factorizing, Systems of simultaneous equations, analytical solutions of a equation, remainder theorem and synthetic division.

UNIT-II 09Hours

Linear Differential Equations: Ordinary differential equations of second order, homogeneous, non-homogeneous with constant and variable coefficient, solving technique of linear differential equations

UNIT-III 11 Hours

Laplace transformation and PDE: Laplace transform of simple functions first and second shifting theorems, Laplace transforms of derivatives integrals and periodic functions. Inverse Laplace transforms and convolution property. Solution of ordinary differential equations related to engineering problems.

UNIT- IV 11 Hours

Frequency distribution: Construction of frequency distribution table and cumulative frequency table.
Graphical representation: Histogram, frequency polygon and cumulative frequency curve.
Measure of central tendency: Mean, Median, partition values, Mode, Measurement of dispersion, Quartile deviation, Mean deviation, Standard deviation.

UNIT- V 12 Hours

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Central composite designs. Illustration through Numerical examples.

Reference books:

1. Kreyzic - Advanced Engineering Mathematics
2. Mallik and Gupta - Numerical Analysis
3. Mallik and Mallik - Numerical Analysis
4. S.S.Sastry - Numerical Analysis
5. M.Shantkumar - Computer based Numerical Analysis
6. F. Ayres (Schaum series) - Differential equations
7. Scield (Schaum series) - Numerical Analysis.
8. V.Rajaraman - Computer oriented Numerical Analysis

9. Samuel D.Counte & Carl - Elementary Numerical Analysis An algorithmic approach.
10. Ronald E, Walpol and Raymond H.Myers - Probability and Statistics for Engineers and Scientists
11. R.Lowell Wine - Statistics for Scientists and Engineers
12. Etwod.G.Kirkpatrick - Introductory Statistics and Probability for Engineering, Science and Technology
13. John.B.Kennedy and Adam.M. Neville - Basic Statistical Methods for Engineers and Scientists
14. Umargi - Probability and Statistical Methods.
15. A.Polland - Introductory Statistics.

Course Outcome: After completion of this course, students will be able to

CO	Statement
CO1	Student is able to design the experiments and develop statistical models for solving mineral processing problems
CO2	Formulate the laboratory experiments with minimum trials
CO3	Identify the key variables of the experiments.

Course: FURNACES AND REFRACTORY	Course Code: 21MNP1S1LT
Teaching Hours/Week (L-T-P): 1 - 1 - 0	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:
The main objective of the course is to develop the usability of refractory minerals in industrial furnaces, design, and fabrication of furnaces for specific applications.

UNIT – I 13 Hours

Furnaces: Types of Furnaces and Classifications, Industrial Applications of Furnaces, Design and Construction aspects of furnaces, chimney design, Process Efficiency. Fundamentals of heat Transfer, Heat Loss, Thermal efficiency of Furnaces, Fuel Economy, Excess Air, and Waste heat Recovery methods.

UNIT-II 13 Hours

Refractory: Refractory Material and Characterization, Types of refractories and their application in boilers and furnace constructions. Properties and testing methods of refractories, manufacture of firebricks, basic, acidic and neutral refractories, refractory mortars, cements and monoliths, special refractory and ceramics. Role of refractories in energy conservation.

Reference Books :

1. Elements of fuels, furnaces and rectories: O.P. Gupta , Khanna Publishers , India.
2. Fuels, Furnaces and refractories : R.C Gupta, PHI Learning Pvt.Ltd., India
3. Principles of extractive Metallurgy : Turkel Rosenqvist ,

Course Outcome: after completion of the course, student will be able to
CO1: Identify the different types of furnaces for specific uses.
CO2 : Identify the refractory property required for efficient operation of furnaces
CO3: Design the furnace for specific applications

Course: Mineralogy Lab	**Course Code:** 21MNP1C1P
Teaching Hours/Week (L-T-P): 0- 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:

1. To Identify and study the properties of different minerals both in hand Specimen and under the microscope.
2. To Prepare the mineral sample for microscopic studies.

List of experiments

1. **Mineralogy:** Megascopic and Microscopic identification of the following Minerals:
2. **Quartz group:** : Important varieties
3. **Felslpars :** Orthoclase, Microcline, Plagioclase, Labradorite
4. **Mica group:** Muscovite, Biotite
5. **Pyroxenes**: Augite, Diopside, Hypersthene
6. **Amphiboles**: Hornblende, Tremolite, Actinolite, Anthophyllite
7. **Other Minerals**: Olivine, Serpentine, Chlorite, Garnet, Talc, Tourmaline, Sillimanite Andalusite, Sillimanite, Kyanite, Corundum, Asbestos, Calcite, Dolomite, Baryte, Magnesite, Fluorite, Gypsum

Course Outcome: after completion of the course, student will be able to

CO	**Statement**
CO1	To identify and differentiate the minerals based on appearance and their properties.
CO2	Suggest the application of Minerals for different end uses
CO3	Appreciate the mineral property by identifying its application useful to mineral separation

Course: Petrology Lab	**Course Code:** 21MNP1C2P
Teaching Hours/Week (L-T-P): 0- 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objective:
To Identify and study the different minerals present in the rocks both in hand specimen and thin sections of the rocks under the microscope.

List of Experiments

1. **Petrology:** Megascopic Identification of following Rocks
2. **Igneous** : Granite,Syenites,Pegmatites,Aplite,
   Diorite,Gabbro, Anorthosite,Dolerties,Rhyolites,Basalts, Ultramafic Rocks: Dunite, Pyroxenite,
   Peridotite, Komatiite
3. **Sedimentary:** Conglomerates, Breccias, Sandstones, Limestones, Dolomite, Shale, Laterites and Bauxites.
4. **Metamorphic:** Schists, Gneisses, Marble, Quartzite, Slate, Phyllite, Amphibolite and Charnockite,Banded Iron Formations

Course Outcome : After completion of this course, students will be able to

CO	Statement
CO1	Appreciate different texture and structures present in rocks.
CO2	Recommend the rocks for different purposes depending upon the properties possessed.

Course: ANALYSIS OF ORES AND MINERALS LAB	**Course Code: :** 21MNP1C3P
Teaching Hours/Week (L-T-P): 0- 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

List of Experiments

Analysis of various elements like
Fe, Mn, Mg, Ca, Pb, Cu, Ni, Ti, V by titrimetric, gravimetric and colorimetric methods.