

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Mineral Processing

SYLLABUS

Master of Science (M.Sc.)/ Master of Technology (M.Tech) (I-IV (VI) Semester)

With effect from 2021-22



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

Semeste	Catagory	ory Subject code Title of the Paper Marks		S	Teaching hours/week			Credit	Duration		
r	Category	Subject coue	The of the Laper	IA	Sem Exam	Total	L	Т	Р		(Hrs)
	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
FIRST	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 Ma	arks			600				24	

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

Semester	Catagowy	Subject code	Title of the Depor		Marks			Teaching hours/week			Durat
	Category	Subject code	The of the raper	IA	SEE	Total	L	Т	Р	Crean	ion of exams (Hrs)
	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	30	70	100	4	-	-	4	3
G			Processes								
Second	DSC8	21MNP2C8L	Indian Mineral Deposits	30	70	100	4	-	-	4	3
	SEC2	21MNIP2S2LT	Computational Techniques in Mineral	20	30	50	1	2	-	2	2
			Processing								
	DSC5P	21MNP2C5P	Ore Microscopy Lab	20	30	50	-	-	4	2	4
1	DSC6P	21MNP2C6P	Comminution and Sizing Lab	20	30	50	-	-	4	2	4
	DSC7P	21MNP2C7P	Ore Classification and Gravity Separation	20	30	50	-	-	4	2	4
			Processes Lab								
			Total Marks			600				24	

Semester		Secking to de	Title of the Derror	Marks			Teaching hours/week			C dit	Duration
	Category Subject code	I the of the Paper		Sem Exam	Total	L	Т	Р	Creun	of exams (Hrs)	
	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				4	-		4	
		21MNP3E1BL	B. Elements of Mining Technology	30	70	100			, -		3
		21MNP3E1CL	C. Heat and Mass Transfer								
	DSE2	21MNP3E2AL	A. Surface Chemistry					-		4	
Thind		21MNP3E2BL	B. Bio Processing	30	70	100	4		-		3
Imru		21MNP3E2CL	C. Dynamics of Machine								
		21MNP3G1AL	A. Basic Techniques of Mineral Dressing								
	GEC1	21MNP3G1BL	B. Principles of Iron Making	20	30	50	2	-	-	2	2
	OLUI	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	Froth Flotation Lab 20 30				-	4	2	4
	Total Mar	·ks				600				24	

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

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

Semester	Catagomy	Subject and	de Title of the Paper IA Sem Exam		8	Te hou	eaching 1rs/week		- Credit	Duration of exams	
	Category	Subject code			Sem Exam	Total	L	Т	Р	Creuit	(Hrs)
	DSC11	21MNP4C11L	Mineral Processing Plant Design	30	70	100	4	-	-	4	3
	DSC12	21MNP4C12L	Ferrous extractive Metallurgy	30	70	100	4	-	-	4	3
		21MNP4E3AL	A. Cement Technology				4	-	-		
	DSE3 21MN 21MN	21MNP4E3BL	B. Industrial Engineering and Management	30	70	100				4	3
Fourth		21MNP4E3CL	C. Pollution control and Eco-System Management								
rourth		21MNP4E4AL	A. Dewatering and Tailing Management							4	3
	DSE4	21MNP4E4BL	B. Advanced Foundry Technology	30	70	100	4	-	-		
		21MNP4E4CL	C. Mineral Engineering Economics								
		21MNP4G2AL	A. Indian Mineral Resources								
	GEC2	21MNP4G2BL	B. Fundamentals of Computer and Office Automation	20	30	50	1		2	2	2
		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	

Semester	Catagory	Subject code	code Title of the Paper	Marks			Teaching hours/week			Cradit	Duration
	Category Subject code		The of the Laper	IA IA		Total	L	T	Р	Cituit	(Hrs)
	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
Fifth	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
	Tot	al Marks			600				24		

M.Tech(Mineral Processing) V-SEMESTER

M.Tech (Mineral Processing) VI-SEMESTER

Semester	Category	Subject code	Title of the Paper	Mar ks Sem. Exam	Total	Toatl Credits	
Sixth	Project	21MNP6R2	Project Report and Viva - Voce	250	250	10	
		21MNP6IT	Industrial Training report	50	50	2	
	Total Marks30012						

(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.

Mise, Miriten (Minerar Processing) Physicster						
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					

M Sc /M Tech (Mineral Processing) First Semester

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

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

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

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

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

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).

11 Hours

11 Hours

11 Hours

10 Hours

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

Wilder and the set of						
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					

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

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 :

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:

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:

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:

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:

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

09Hours

11 Hours

11 Hours

12 Hours

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.
- Best, M.G., 2002, Igneous and metamorphic petrology, 2nd Edition, 3. **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

- Blatt, Middleton & Murray (1980) Origin of sedimentary rocks. Printice Hall Inc
 Pettijohn, F.J. (1975) Sedimentary rocks. Harper and Row Publ., New Delhi
 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.

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

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

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

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

UNIT-II

09 Hours

11 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

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

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

UNIT- V

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

09 Hours

11 Hours

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

	8/
Course: APPLIED MATHEMATICS	Course Code: 21MNP1C3L
AND EXPERIMENTAL DESIGN	
Teaching Hours/Week (L-T-P): 4 - 0 - 0	No. of Credits: 04
Internal Assessment: 30 Marks	Semester End Examination: 70 Marks

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

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

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

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

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

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

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.

11 Hours

11 Hours

09 Hours

09Hours

- 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

Hours of Furnaces, Design and

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

13

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
- 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	Course Code: : 21MNP1C3P
MINERALS LAB	
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.