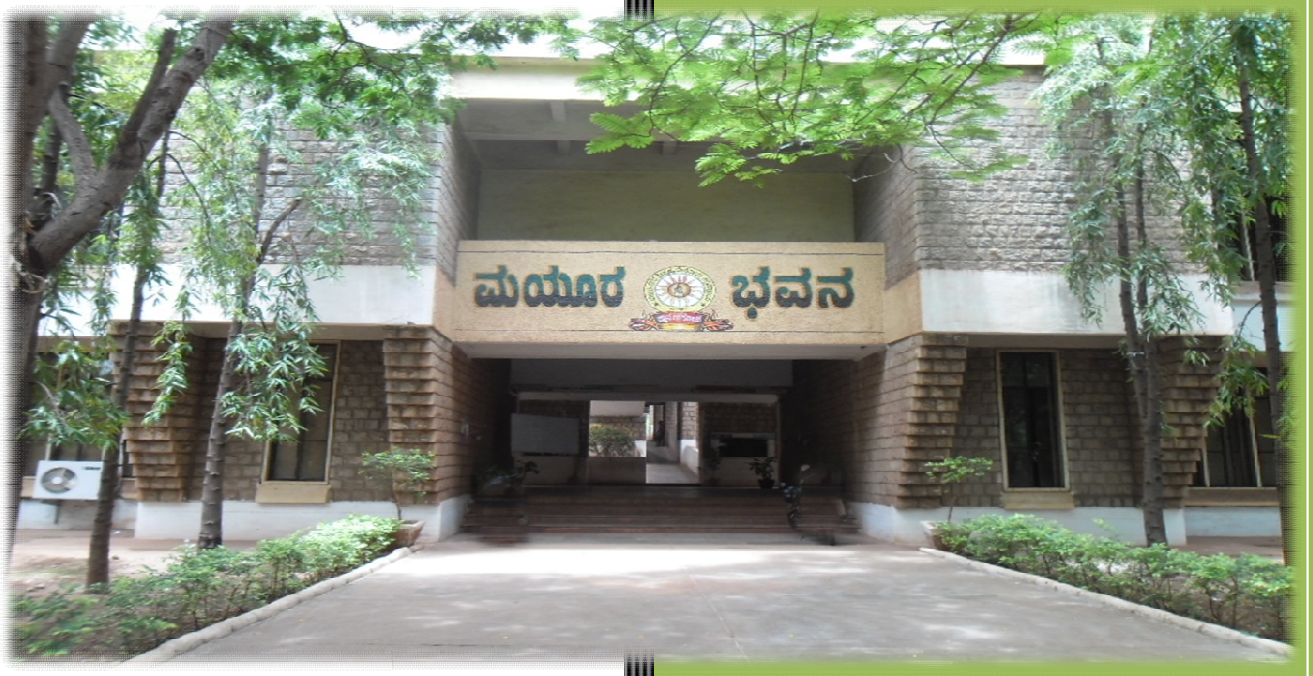
Syllabus

2019-20 on words

M.Tech. [Mineral Processing]

CBCS Programme



Department of Studies and Research in Mineral Processing

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M.Tech (Mineral Processing) CBCS Programme syllabus for regular 6 semester and 4 semester lateral entry is effective from the year 2019-20. The syllabus was scrutinized and recommended in BOS in Mineral Processing held on 07.03.2019, at the Department of Studies and Research in Mineral Processing VSKU Post Graduate Centre, Nandihalli-Sandur; by the following BOS members

Name	Designation	Signature with Date
Prof. S.J. Gopalkrishna	Chairman BOS	07/03/2019
Prof. P.C. Naganoor,	Member	
Prof. M.R. Patil	Member	7/3/19
Dr. P. Sharathkumar	Member	7.3.19
Prof. C. Venkataiah'	Member	7/3/19
Prof. M.D. Khanadali	Member	7/3/19
Prof. G. Chandrakanth Dept. of Applied Geology Kuvempu University, Shivamogga	External Member	7/3/2019
Prof. M. Aruna Dept. of Mining Engineering, NITK Surathkal	External Member	7/3/2019

PREAMBLE

M.TECH (MINERAL PROCESSING) CBCS PROGRAMME

The backbone of the economy of any nation is its natural resources especially theland, water and mineral and their potential utilization. The water, forest and farm resourcesare renewable part and whereas the mineral resources are non-renewable part and getprogressively exhausted as they are mined and removed. Therefore, it is imminent thatgreatest care has to be exercised in planning and judicious utilization of these precious, non-renewable mineral resources. India is bestowed with wide variety of minerals. India is not apoor country in mineral wealth, an increased attention has to be paid with respect to theproper utilization of these available natural resources.

The noted physicist and noble laureate Dr.C.V.Raman, has observed that "Unless weknow the value of minerals, know-how to utilize them, promote the welfare of the country,we should let them lie in ground. The making use of a mineral is as important as finding it."

Resources are known. Socio-enviro-technological advances have to be evolved for the judicious utilization of these available resources. The high grade ores are on fast decline warranting the use of lean grade ores to meet the demands of the user industry. In this contextmineral beneficiation is inevitable. Mineral processing also known as Ore dressing, Mineraldressing and better known as Mineral Processing Technology is a unique andmultidisciplinary post graduate programme. The programme is potential enough to addressthe burning issues of the mineral industry ie from mine to metal. M.Tech (MineralProcessing) is 3 Year (6 Semester) post graduate programme structured with engineering andother allied subjects to harness the young talents of the country. 15 Hard Core papers, 10 Soft Core papers and 15 Hard Core Practicals are taught. 6th semester (in III Year) isdedicated to project work (dissertation) of industrial related application or fundamentalstudies has to be carried out by the students. The duration of the project work is 4 months.

The syllabii is orderly structured and sequentialised with the needs of the mineral industry. The information and the contents of the programme and their industrial applications is continuously passed on to the students to keep them abreast of the present day developments in the mineral industry.

M.TECH. (MINERAL PROCESSING) CBCS PROGRAMME

STRUCTURE AND SYLLABUS

FIRST SEMESTER

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 1.1	Mineralogy	4 – 0 – 0	4	3	30	70
2	MP HC – 1.2	Petrology and Elements of Mining	4 – 0 – 0	4	3	30	70
3	MP HC – 1.3	Engineering Mathematics – I	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 1.4	Elements of Electrical Engineering	3 – 0 – 0	3	3	25	50
5	MP SC – 1.5	Elements of Mechanical Engineering	3 – 0 – 0	3	3	25	50
6	MP SC – 1.6	Mining Geology	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 1.7	Mineralogy Lab	0 – 0 – 4	2	4	--	50
8	MPL HC – 1.8	Mechanical Engineering Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 1.9	Electrical Engineering Lab	0 – 0 – 4	2	4	--	50
			TOTAL	**24**		**140**	**460**
Total Marks for First Semester 600							

SECOND SEMESTER

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 2.1	Ore Geology	4 – 0 – 0	4	3	30	70
2	MP HC – 2.2	Assaying	4 – 0 – 0	4	3	30	70
3	MP HC – 2.3	Engineering Mathematics – II	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 2.4	Testing of Materials & Transport Phenomenon	3 – 0 – 0	3	3	25	50
5	MP SC – 2.5	Computer Basics and Programming in C & C++	3 – 0 – 0	3	3	25	50
6	MP SC – 2.6	Heat and Mass Transfer	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 2.7	Assaying Lab – I	0 – 0 – 4	2	4	--	50
8	MPL HC – 2.8	Petrology Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 2.9	Computer Basics& Programming in C&C++ Lab	0 – 0 – 4	2	4	--	50
Open Elective Paper (Other Department Students) – Theory (Any One)							
1	MP OE – 1	Study of Minerals and Rocks	4 – 0 – 0	4	3	30	70
2	MP OE – 2	Mineral Resources of India	4 – 0 – 0	4	3	30	70
		TOTAL		**28**		**170**	**530**
Total Marks for Second Semester 700							

THIRD SEMESTER

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 3.1	Ore Microscopy & Research Methodology	4 – 0 – 0	4	3	30	70
2	MP HC – 3.2	Mineral Processing – I	4 – 0 – 0	4	3	30	70
3	MP HC – 3.3	Coal Preparation & Fuel Technology	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 3.4	Surface Chemistry	3 – 0 – 0	3	3	25	50
5	MP SC – 3.5	Indian Mineral Deposits and Plant Flow sheets	3 – 0 – 0	3	3	25	50
6	MP SC – 3.6	Bio Processing	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 3.7	Ores and Ore Microscopy Lab	0 – 0 – 4	2	4	--	50
8	MPL HC – 3.8	Comminution and Classification Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 3.9	Assaying Lab – II	0 – 0 – 4	2	4	--	50
Open Elective Paper (Other Department Students) – Theory (Any One)							
10	MP OE –3	Introduction to Mineral Processing	4 – 0 – 0	4	3	30	70
11	MP OE – 4	Iron and Steel Making	4 – 0 – 0	4	3	30	70
		TOTAL		**28**		**170**	**530**
Total Marks for Third Semester 700							

FIRST SEMESTER FOR LATERAL ENTRY

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 1.1	Mineralogy	4 – 0 – 0	4	3	30	70
2	MP HC – 3.1	Ore Microscopy & Research Methodology	4 – 0 – 0	4	3	30	70
3	MP HC – 3.2	Mineral Processing – I	4 – 0 – 0	4	3	30	70
4	MP HC – 3.3	Coal Preparation & Fuel Technology	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
5	MP SC – 3.4	Surface Chemistry	3 – 0 – 0	3	3	25	50
6	MP SC – 3.5	Indian Mineral Deposits and Plant Flow sheets	3 – 0 – 0	3	3	25	50
7	MP SC – 3.6	Bio Processing	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
8	MPL HC – 3.7	Ores and Ore Microscopy Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 3.8	Comminution and Classification Lab	0 – 0 – 4	2	4	--	50
10	MPL HC – 3.9	Assaying Lab – II	0 – 0 – 4	2	4	--	50
			TOTAL	**28**		**170**	**530**
Total Marks for First Semesterof Lateral Entry 700							

FOURTH SEMESTER

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 4.1	Mineral Processing – II	4 – 0 – 0	4	3	30	70
2	MP HC – 4.2	Non Ferrous Extractive Metallurgy	4 – 0 – 0	4	3	30	70
3	MP HC – 4.3	Mineral Processing – III	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 4.4	Mineral Processing Plant Design – I	3 – 0 – 0	3	3	25	50
5	MP SC – 4.5	Process Control & Automation	3 – 0 – 0	3	3	25	50
6	MP SC – 4.6	Industrial Management	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 4.7	Gravity and Magnetic Separation Lab	0 – 0 – 4	2	4	--	50
8	MPL HC – 4.8	Metallurgy Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 4.9	Coal Preparation Lab	0 – 0 – 4	2	4	--	50
		TOTAL		**24**		**140**	**460**
Total Marks for Fourth Semester 600							

SECOND SEMESTER FOR LATERAL ENTRY

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 2.1	Ore Geology	4 – 0 – 0	4	3	30	70
2	MP HC – 4.1	Mineral Processing – II	4 – 0 – 0	4	3	30	70
3	MP HC – 4.2	Non Ferrous Extractive Metallurgy	4 – 0 – 0	4	3	30	70
4	MP HC – 4.3	Mineral Processing – III	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
5	MP SC – 4.4	Mineral Processing Plant Design – I	3 – 0 – 0	3	3	25	50
6	MP SC – 4.5	Process Control & Automation	3 – 0 – 0	3	3	25	50
7	MP SC – 4.6	Industrial Management	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
8	MPL HC – 4.7	Gravity and Magnetic Separation Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 4.8	Metallurgy Lab	0 – 0 – 4	2	4	--	50
10	MPL HC – 4.9	Coal Preparation Lab	0 – 0 – 4	2	4	--	50
Open Elective Paper (Other Department Students) – Theory (Any One)							
11	MP OE – 1	Study of Minerals and Rocks	4 – 0 – 0	4	3	30	70
12	MP OE – 2	Mineral Resources of India	4 – 0 – 0	4	3	30	70
			TOTAL	**32**		**200**	**600**
Total Marks for Second Semester of Lateral Entry 800							

FIFTH SEMESTER

SL. NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY / LAB
Hard Core Papers – Theory							
1	MP HC – 5.1	Environmental Management & Mineral Processing Economics	4 – 0 – 0	4	3	30	70
2	MP HC – 5.2	Agglomeration & Cement Making	4 – 0 – 0	4	3	30	70
3	MP HC – 5.3	Ferrous Extractive Metallurgy	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 5.4	Mineral Processing Plant Design – II	3 – 0 – 0	3	3	25	50
5	MP SC – 5.5	Simulation & Modeling	3 – 0 – 0	3	3	25	50
6	MP SC – 5.6	Waste Recycling	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 5.7	Flotation and Dewatering Lab	0 – 0 – 4	2	4	--	50
8	MPL HC – 5.8	Agglomeration Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 5.9	Simulation & Modeling Lab	0 – 0 – 4	2	4	--	50
		TOTAL		**24**		**140**	**460**
Total Marks for Fifth Semester 600							

THIRD SEMESTER FOR LATERAL ENTRY

SL.NO.	SUBJECT CODE	TITLE OF THE PAPER	L – T – P (Hours)	CREDITS	EXAM HOURS	MARKS	
						INTERNAL ASSESSMENT	THEORY/ LAB
Hard Core Papers – Theory							
1	MP HC – 5.1	Environmental Management & Mineral Processing Economics	4 – 0 – 0	4	3	30	70
2	MP HC – 5.2	Agglomeration & Cement Making	4 – 0 – 0	4	3	30	70
3	MP HC – 5.3	Ferrous Extractive Metallurgy	4 – 0 – 0	4	3	30	70
Soft Core Papers – Theory (Any two)							
4	MP SC – 5.4	Mineral Processing Plant Design – II	3 – 0 – 0	3	3	25	50
5	MP SC – 5.5	Simulation & Modeling	3 – 0 – 0	3	3	25	50
6	MP SC – 5.6	Waste Recycling	3 – 0 – 0	3	3	25	50
Hard Core Papers – Practical							
7	MPL HC – 5.7	Flotation and Dewatering Lab	0 – 0 – 4	2	4	--	50
8	MPL HC – 5.8	Agglomeration Lab	0 – 0 – 4	2	4	--	50
9	MPL HC – 5.9	Simulation & Modeling Lab	0 – 0 – 4	2	4	--	50
Open Elective Paper (Other Department Students) – Theory (Any One)							
10	MP OE – 3	Introduction to Mineral Processing	4 – 0 – 0	4	3	30	70
11	MP OE – 4	Iron and Steel Making	4 – 0 – 0	4	3	30	70
			TOTAL	**28**		**170**	**530**
Total Marks for Third Semester of Lateral Entry 700							

SIXTH SEMESTER / FOURTH SEMESTER FOR LATERAL ENTRY

SL.NO.	SUBJECT CODE	TITLE OF THE PAPER	CREDITS	MARKS
Dissertation work				
1	MP HC – 6.1	Dissertation	8	200
2	MP HC – 6.2	Viva - Voce on Dissertation	4	100
3	MP HC – 6.3	Industrial Training	--	--
4	MP HC – 6.4	Industrial Tour Report	--	--
		TOTAL	**12**	**300**
Total Marks for Sixth Semester 300 / Total Marks for Fourth Semester of Lateral Entry 300				

Credits / Marks of matrix for M.Tech Mineral Processing (Six Semesters)

Credits / Marks			COURSES	Semesters																
Credits (C)	Papers (P)	Marks (M)		I SEM			II SEM			III SEM			IV SEM			V SEM			VI SEM		
				C	P	M	C	P	M	C	P	M	C	P	M	C	P	M	C	P	M
102	**32**	**2550**	**Hard Core**	18	6	450	18	6	450	18	6	450	18	6	450	18	6	450	12	2	300
30	**10**	**750**	**Soft Core**	6	2	150	6	2	150	6	2	150	6	2	150	6	2	150	--	--	--
8	**2**	**200**	**Open Elective**	--	--	--	4	1	100	4	1	100	--	--	--	--	--	--	--	--	--
140	**44**	**3500**	**TOTAL**	**24**	**8**	**600**	**28**	**9**	**700**	**28**	**9**	**700**	**24**	**8**	**600**	**24**	**8**	**600**	**12**	**2**	**300**

Credits / Marks of matrix for M.Tech Mineral Processing (Four Semesters) Lateral Entry

Credits / Marks			COURSES	Semesters											
Credits (C)	Papers (P)	Marks (M)		I SEM			II SEM			III SEM			IV SEM		
				C	P	M	C	P	M	C	P	M	C	P	M
74	**22**	**1850**	**Hard Core**	22	7	550	22	7	550	18	7	450	12	2	300
18	**6**	**450**	**Soft Core**	6	2	150	6	2	150	6	2	150	--	--	--
8	**2**	**200**	**Open Elective**	--	--	--	4	1	100	4	1	100	--	--	--
100	**30**	**2500**	**TOTAL**	**28**	**9**	**700**	**32**	**10**	**800**	**28**	**9**	**700**	**12**	**2**	**300**

M.Tech. (Mineral Processing) Regulations

1. A candidate with **B.Sc. degree having combination of any three of the following subjects Geology / Physics / Chemistry / Mathematics / Computer Science / Statistics / Electronics** and or any B.Sc degree having studied Mathematics and Physics at PUC level are also eligible for admission to I year M.Tech (Mineral Processing) CBCS Program.

2. Candidates with **B.E. / B.Tech**. Degree in Mineral engineering, Mining Engineering, Chemical Engineering, Civil Engineering, Metallurgy, Materials Engineering, Mechanical Engineering, Industrial Production and Electrical Engineering are only eligible to M.Tech (Mineral Processing) lateral entry, directly to III Semester.

3. Hard Core Subjects are Compulsory. Candidates have to select any **Two** Soft-Core subjects.

4. **One Open Elective** subject shall be chosen by the students from the subject offered by the other Departments during **II & III Semesters.**

5. For practical examinations a batch shall consists of not more than **Eight** Students. Students are not permitted to take the practical examination without the submission of the Certified Laboratory Records. **35 marks** are allotted for carrying out of experiment and write-up of results and **10 marks** are allotted to **Viva-Voce** and **5 Marks for Laboratory Records**.

6. After the completion of **II & IV Semester**, students are sent for Plant Visits and Industrial Training/s respectively. **One or Two** Faculty members may accompany or visit the work place at least once during the training period for supervision. TA/DA has to be paid for the faculty members for their visit as per the University norms. Plant visits, Industrial training and Tours are compulsory

7. The students of ***V Semester of Regular Entry Mode and III Semester of Lateral Entry Mode*** have to undertake the Industrial Tour for a period of 15 days. Two Faculty members and one non teaching staff member have to accompany the students

for tour. TA/DA has to be paid for the faculty members and non teaching staff for their visit as per the University norms

8. The students have to undertake a Project Work During their ***VI Semester for Regular Entry Mode*** and ***IV Semester for Lateral Entry Mode*** in the Department or in any well established Mineral based organization / laboratory for a period of 4 months and have to submit their dissertation report. The **Project Report** has **8 Credits** and **Viva-Voce** has **4 Credits**. The Candidate should present the dissertation work before the Viva-Voce Committee consisting of BOE-Chairman and members, Chairman of the Department and their respective Guides.

9. Two seats may be reserved for industry sponsored candidates

10. All other conditions are as per the University Rules and Regulations promulgated from time to time.

11. The grade and the grade point earned by the candidate in the subject will be as given below:

P	G	GP = V x G
90 – 100	9 (A++)	V x 9
80 – 89	8 (A+)	V x 8
70 – 79	7 (A)	V x 7
60 – 69	6 (B+)	V x 6
50 – 59	5 (B)	V x 5
00 – 49	0 (C)	V x 0

Here, P is the percentage of marks secured by a candidate in a course which isrounded tonearest integer. V is the credit value of the course. G is the grade andGP is the grade point.

If G=0(C), (GP=0) then the candidate is assumed to have automatically dropped the course. He/she is not said to have failed in the course.

12. **The format for Hardcore and Open Elective Theory Paper for 70 Marks of 3 Hours duration**

Section 1: Consists of 10 questions of 2 marks each covering all the units.
(2 X 10 = 20 marks)

Section 2: Consist of 4 Sub Questions with 5 marks each with choice; with total number of question not exceeding 6 covering all the units.
(5 X 4 = 20 marks)

Section 3: Consist of 3 Sub Questions with 10 marks each with choice, the total number of question not exceeding 4, covering all the units.
(10 X 3 = 30 marks)

13. The format for Soft core theory paper for 50 marks of 3 Hours duration.

Section 1: Consists of 10 questions of 1 mark each covering all the units.
(1 X 10 = 10 marks)

Section 2: Consist of 4 Sub Questions with 5 marks each with choice; with total number of question not exceeding 6 covering all the units.
(5 X 4 = 20 marks)

Section 3: Consist of 2 Sub Questions with 10 marks each with choice, the total number of question not exceeding 4 covering all the units.
(10 X 2 = 20 marks)

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Prof. P.C. Naganoor,	Member	
Prof. M.R. Patil	Member	7/3/19
Dr. P. Sharathkumar	Member	7.3.19
Prof. C. Venkataiah'	Member	7/3/19
Prof. M.D. Khanadali	Member	7/3/19
Prof. G. Chandrakanth Dept. of Applied Geology Kuvempu University, Shivamogga	External Member	7/3/2019
Prof. M. Aruna Dept. of Mining Engineering, NITK Surathkal	External Member	7/3/2019

FIRST SEMESTER

MP HC - 1.1 MINERALOGY (Compulsory paper for lateral entry students)			
Subject Code	MP HC- 1.1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I	**13 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	**13 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. 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- III	**13 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 – IV	**13 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).	

Reference books:

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

MP HC - 1.2 PETROLOGY AND ELEMENTS OF MINING			
Subject Code	MP HC- 1.2	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**15 Hours**
Petrology: Magma and its origin. Primary and Derivative magmas. Bowen's reaction principle. Diversity of Igneous rocks – Differentiation; Gravitational, Filter pressing, liquid immiscibility, fractional crystallization, role of volatiles in magmatic evolution and Assimilation**. Igneous rocks**: Forms, Structure and Textures of Igneous Rocks. Classification and types of igneous rocks			
Unit-II			**11 Hours**
Sedimentary Rocks: Process of sedimentation, types and agents of weathering,transportation, deposition, diagenesis and lithification. Structures of sedimentary rocks: Bedding, Current bedding, Cross bedding, graded bedding, Ripple marks, Mud cracks etc. Classification of sedimentary rocks. Clastic and non-clastic sediments. Origin, occurrence and characteristics of common sedimentary rocks.			
Unit-III			**11 Hours**
Metamorphic Rocks: Types and Agents of metamorphism. Textures and structures of metamorphic rocks. Metasomatism. Composition, origin and mode of occurrence of Gneisses, Amphibolites,Granulites, Schists and eclogites rocks.			
Unit- III			**15 Hours**
Elements of Mining: Introduction and definition of mining terminology. Sampling: Sampling techniques. Mining Methods: Important methods of Open cast, underground and alluvial mining. Coal mining methods. Unit operations: Drilling, Blasting, Loading and Transportation. Safety. Ventilation and illumination in underground mines. Mines support. Hazards in underground mines and their control. Impact of mining on environment. Reclamation. Legislation & Safety.			

Reference books:

1. G.W.Tyrrel - Principles of Petrology
2. J.F.Pettijohn - Sedimentary Rock
3. Turner and Verhoogan - Igneous and Metamorphic Petrology

4. A.Hrake - Petrology for Students
5. M.Best - Igneous and Metamorphic Petrology
6. R.N.P.Arogyaswamy - A Course in Mining Geology
7. Mackinstry - Mining Geology
8. D.J.Deshmukh - Elements of Mining Technology Vol. I & II
9. Peele Robert - Mining Engineers Hand Book Vol. I & II
10. Hyndman – Petrology
11. Eenest G Ehlers/Harvey Blatt – Petrology (Igneous, Sedimentary and Metamorphic)
12. McBirney - Igneous Petrology
13. Anthoney R Phillpots - Principles of Igneous and Metamorphic Petrology
14. M K Bose - Igneous Petrology
15. Alokh K Gupta - Petrology of Igneous rocks
16. B Bhaskar Rao - Metamorphic Petrology
17. W D Winter - Igneous and Metamorphic Petrology
18. Loren A Raymond - Petrology (Igneous, Sedimentary and Metamorphic)

MP HC - 1.3 ENGINEERING MATHEMATICS - I			
Subject Code	MP HC- 1.3	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Algebra : Matrices, Determinants, Progressions(arithmetic and geometric),Permutation and Combinations Binomial theorem. **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. **Linear Differential Equations:** Ordinary differential equations of second order, homogeneous, non-homogeneous with constant and variable coefficient, solving technique of linear differential equations			
Unit-II			**13 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- III			**13 Hours**
Allied Angles and Compound Angles : a) Recapitulation of angle measurement, trigonometric ratios and standard angles. **Allied angles:** Meaning of allied angles. Signs of trigonometric ratios. Trigonometric ratios of allied angles in terms of θ .Problems on allied angles. b) **Compound angles** : Geometrical proof of sin (A+B) and cos (A+B) and hence deduce tan (A+B). Write the formulae for sin(A – B), cos (A – B) and tan (A – B),problems. Multiple and sub multiple angle formulae for 2A and 3A. Simple problems. Transformation formulae. Expression for sum or difference of sine or cosine of angles into product form. Expression for product of sine and cosine of angles into sum or difference form.			

Unit- IV	13 Hours
Vectors : Defination of vector. Representation of vector as a directed line segment. Magnitude of a vector. Types of vectors. Position vectors. Expresssion of vector by means of position vectors. Addition and subtraction of vectors in terms of line segment.Vectors in plane and vector in a space in terms of unit vector I, j and k respectively. Product of vectors. Scalar product and vector product of two vectors. Geometrical meaning of scalar and vector products. Application of dot (scalar) and cross(vector products. Projection of a vector on another vector. Area of parallelogram and area of triangle. Work done by force and moment of force.	

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. P. 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.

MPSC 1.4 ELEMENTS OF ELECTRICAL ENGINEEING			
Subject Code	MP SC- 1.5	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**10 Hours**
D.C.Circuits: Ohm's law, Kirchoff's law, current division principle, solution of networks using C-Kirchoff's law. Principle of superposition. Electromagnetism: Basic definitions, solution of series and parallel magnetic circuits, Hysterisis, Faraday's laws of electromagnetic induction, Lenz's law, concept of self and mutual induction. Energy stored in a magnetic field. Rise and decay of currents in inductive circuits .A.C.Circuits: Generation of alternating emfs, average and effective values of sine wave. Form factor and peak factor, Phasor representation of alternating quantities, voltage, current and power relations in simple series circuits containing resistance, inductance and capacitance, Power in single phase circuits, Power factor			

Unit-II	**10 Hours**
Generation of 3 phase voltages. Advantages of 3 phase system, star and delta connections, Relationship between line and phase quantities, power in 3 phase circuits. Measurement of power using two watt meter method.D.C.Machines: Constructional features, principles of operation, generators and motors, e.m.f.equation, speed control of D.C. motors, starters. Efficiency of D.C.generators and motors.	
Unit- III	**10Hours**
Transformers: Constructional features, principles of operation. Transformers on no-load and on-load, regulation, losses and efficiency. OC and AC test to predetermine efficiency and regulation. Three phase transformers, star and delta connections. Auto transformers and welding transformers.Alternators : Constructional features, principles of operation, e.m.f. equation with distribution and coil spar factor. Three phase induction motors: Construction, types, principle of operation, output, losses and efficiency, torque, slip, characteristics of starting torque, starting speed control. Star-delta starters, applications.	
Unit- IV	**9 Hours**
Measuring Instruments: Classification, essentials of Indicating instruments, construction and working principles of – Moving iron and moving coil Voltameter and Ammeter, Dynamometer type wattmeter, single phase energy meter, Megger and C.R.O.Fuse: Necessity of fuse, rewireble and H.R.C. cartridge fuse. Earthing: Purpose and methods of earthing	

Reference books:

1. B.L.Theraja - A Text book of Electrical Technology
2. S.L.Uppal - Electrical Engineering
3. S.K.Sahdev & D.S.Rana - Elements of Electrical Science
4. E.Hughes - Electrical Technology
5. H.Cotton - Electrical Technology

MP SC - 1.5 ELEMENTS OF MECHANICAL ENGINEERING			
Subject Code	MP SC- 1.4	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**10 Hours**
Energy – Introduction, Sources of energy,Fuels - Nuclear, Tidal, Wind, Solar etc. Prime Movers: Types of prime movers. Definition of terms - Pressure, Work, Temperature, Heat, Power, Units of heat, Specific heat, Mechanical equivalent heat. Friction : Definition, Types of frictions, Limiting friction, limiting angle of friction, Coefficient of friction, Laws of solid friction and effects of friction. Lubrication : Definition, necessity, types and properties of lubricants. Methods of lubrication. Lubricators - Screw cap lubricator, Drop feed lubricator and Splash lubricator			
Unit-II			**10 Hours**
Couplings : Definition and types - Muff, Flange and Flexible. Clutches : Definition, Necessity, Single plate and multi plate clutch and cone clutches. Brakes: Types of brakes - Block and Bond brake, Internal expanding brake. Difference between brake and clutch. Bearings: Definition of Shaft, Spindle and Axle. Types of bearings – Journal bearing, Foot step bearing, Collar bearing, Antifriction bearing, Ball and Roller bearings. Power Transmission: Methods of Motion and Power transmission.			

Unit- III	**10 Hours**
Belt Drive – Types - Open and Cross belt drive, Velocity ratio, Slip and creep, Guide Pulley, Jackey pulley, Stepped cone pulley, crowning of pulleys, Fast and Loose pulley. Belt Drive - Advantages of over Belt Drive. Chain Drive- elements of chain drive and advantages. Gear Drive – Advantages of gear drive. Types of Gears – Spur, Helical, Spiral, Bevel, Worm and Worm wheel, Rack and Pinion. Velocity ratio of Gear Drive, Gear train – Definition, types (simple and compound), Simple problems on Belt and GearDrive.Pumps : Definition, Classification of pumps, Reciprocating pump,Centrifugal pumps, Gear pump, Priming of pumps, Air vessels, Simple problems.	
Unit – IV	**9 Hours**
Lathes : Types of lathes, description and functions of Lathe parts, Accessories and attachments, Lathe operations – Turning, Taper turning and their methods. Thread cutting, Knurling, Problems on taper cutting and thread cutting.Drilling Machine : Types of drilling machines, Drilling operations, Drill bits – types, cutting speed, feed and depth of cut. **Vibration :** Introduction, Natural and forced vibrations. Effects of vibration. Remedies to avoid vibrations. Wear: Different types of wears – Abrasion, Corrosion, Scoring, Scuffing, Pitting, Scaling. Minimization of wear with examples. Metrology : Various height Gauges, Micrometer, Bourdan Tube Pressure Gauge.	

Reference books:

1. K.P.Roy, S.K.Hazrachoudhary & A.K.Hazrachoudhary - Elements of Mechanical Engineering
2. K.P.Roy, S.K.Hazrachoudhary & A.K.Hazrachoudhary - Elements of Workshop Technology Vol. I & II
3. K.R.Gopalkrishna - Elements of Mechanical Engineering
4. N.D.Bhatt - Machine Drawing
5. K.R.Gopalkrishna - Machine Drawing

MP SC: 1.6 MINING GEOLOGY			
Subject Code	MP SC- 1.6	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**11 Hours**
Geological exploration: Geological mapping; its need, scope, technique and choice of the scale. Mineral exploration, its significance and objectives. Geological classification of the areas for mineral exploration. Collection of geological data. Exploration programme, selection of area, planning, organization and various stages of exploration. Geological parameters for mine planning and design. Methods of choice of sampling different geological formations. Concept of ore reserve, resource and methods of classification of ore reserves as proposed by various organizations. Methods of report writing and presentation of data. Guides to Ore- Introduction: Targets and Loci**:** Ringed Targets. Intersecting Loci. Classification of Guides- Regional guides and guides of local imporatance. Physiographic Guides**:** Topographic Expressions of ore bodies: Deceptive outcrops. Physiographic environment of ore Deposits: Topography as a guide to iron ore. Physiographic relations of Placer Deposits: Guides to channels; Location of pay streaks. Physiographic in relation to oxidation and enrichment: Residual ores; Supergene sulphide zones**.** Geobotonical and Biogeochemcial guides.			

Unit-II	10 Hours
Mineralogical Guides: Rock Alteration: Nature of alteration; Target rings of alteration, Mineralogical guides to solution-paths; Hypogene zoning as a guide. Oxidation products at depth; Unoxidized ore in outcrops; Minable oxidized ore; Surface oxidation products as indicators; Metals in the oxidized zone; Significance of gangue; Types of limonite derived from sulphides and other minerals.	
Unit- III	**8 Hours**
Stratigraphic and lithologic guides in Syngenetic Deposits and in Epigenetic deposits, Reasons for favorability, Competent Vs. incompetent formations, Examples of favorable formations and Application	
Unit- IV	**10 Hours**
Fracture patterns as guides: Mechanical Principles of Fracturing, Stress: Planes of principal stress, the pattern of principal stress, Relation of fractures to stress: Characteristics of shears and tension fractures, Forces causing fracturing. Vein patterns: typical vein patterns and their Applications, Vein structures within the pattern, Localization of ore shoots within the fracture pattern.Contacts and folds as guides: Contacts, Folds younger than the ore, Folds older than the ore	

Reference books:

1. Mackinstry - Mining geology
2. RNP Aroga swamy - Mining Geology

MPL HC - 1.7 MINERALOGY LAB
Megascopic and Microscopic identification of the following Minerals: **Quartz group:** Important varieties **Felslpars:** Orthoclase, Microcline, Plagioclase, Labradorite **Mica group:** Muscovite, Biotite **Pyroxenes:** Augite, Diopside, Hypersthene **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.
MPL HC - 1.8 MECHANICAL ENGINEERING LAB:
Machine Shop: Jobs on plane turning, step turning, knurling and taper turning. Engineering Drawing: First angle projection, Orthographic projection of simple solids like prism, pyramid, cylinder, cone. Conversion of pictorial view into orthographic view involving sectional views. Isometric view of simple objects like cube, cylinder, cone, prism and the combinations
MPL HC - 1.9 ELECTRICAL ENGINEERING LAB:
Voltage and current relations & measurement of power using two wattmeters in Star and delta connected loads, Measurement of Inductance by VAW method, Calibration of single phase Energy meter, Determination of voltage, current and frequency with the help of CRO. Speed control of D.C. shunt motor by armature control and field control methods. Load test on D.C. shunt motor. Load test on single phase transformer.O.C. and S.C. tests on single phase transformer. Load test on three phase induction motor.

SECOND SEMESTER

MP HC - 2.1 ORE GEOLOGY (Compulsory subject for lateral entry students)			
Subject Code	MP HC- 2.1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Introduction to ore geology: magmas and magmatic ore formations – differentiation, concentration, magma mixing, sublimation etc.			
Unit-II			13 Hours
Hydrothermal process – cavity filling, contact metasomatism, replacement; wall rock alteration, mineral paragenesis and zoning in mineral deposits. Geological thermometers. Ore deposits associated with acidic, mafic and ultramafic rocks layered intrusive and the associated ore deposits mineral deposits associated with kimberlites, komatites and carbonatites. Classification of ore deposits.			
Unit-III			**13 Hours**
Ore deposits formed by sedimentary processes: Iron, Manganese, Carbonates, Phosphates, Sulphates, and Clay deposits. Uranium and Vanadium deposits and Non-Ferrous ores. Evaporation, Residual and Mechanical concentration, factors controlling residual concentration. Process of formation of residual deposits- Bauxite and Nickel. Ore Deposits formed by Oxidation and Supergene enrichment-factors controlling supergene enrichment. Mode of formation of placer deposits.			
Unit- IV			**13 Hours**
Ore deposits associated with metamorphism: Graphite, Asbestos, Talc, Soapstone, Andulasite, Sillimanite, Kyanite and Garnet. Metallogenic epochs and provinces. Ore deposits related to plate tectonics, control of Ore localization.			

Reference books:

1. Jensen and Bateman, A.M. - Economic Mineral Deposits
2. K.V.G.K. Gokhale & T.C.Rao - Ore Deposits of India
3. R.L.Stanton - Ore Petrology
4. C.F.Park (Jr) and Mac Diarmid - Ore Deposits
5. W. Lindgren - Mineral Deposits

MP HC - 2.2 ASSAYING			
Subject Code	MP HC- 2.2	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Introduction, Sampling, Common apparatus and techniques, Accuracy and Precision. Separation techniques: Solvent extraction, Ion-exchange and brief idea about Chromatography			
Unit-II			**13 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. 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- III			**13 Hours**
Spectral Methods of Analysis: Principles, Instrumentation and application of Colorimetry and Spectro photometry, Flame photometry, Atomic Absorption Spectrometry and Flame emission spectroscopy			
Unit- IV			**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

MP HC 2.3 ENGINEERING MATHEMATICS - II			
Subject Code	MP HC- 2.3	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I **13 Hours**

Finite differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems. **Numerical integration:** : Simpson's (1/3)th and (3/8)th rules, Weddle's rule (without proof) –Problems

Unit-II **13 Hours**

Numerical Methods: Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's method. Runge - Kutta method of fourth order, Milne's and Adams-Bashforth predictor and corrector methods (No derivations of formulae-single step computation only).

Unit- III **13 Hours**

Statistical Methods: Review of measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems

Straight lines: Different forms of equations of straight lines

y = mx + c ,

$$(y - y_1) = m(x - x_1)$$

$$(y - y_1) = \left(\frac{y_2 - y_1}{x_{2-}x_1}\right)(x - x_1)$$

General equation of the line ax + by + c = 0 (graphical representation and statements) and problems on the above equations. Equation of lines through a point and parallel or perpendicular line

Unit- IV **13 Hours**

Probability Distributions: Random variables (discrete and continuous), probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems. **Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient

Reference books:

1. Mallik and Gupta Numerical Analysis
2. B.V. Ramana "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006
3. N.P.Bali and Manish Goyal "A text book of Engineering mathematics", Laxmi publications, latest edition.
4. F. Ayres (Schaum series) Differential equations.
5. H.K. Dass and Er. RajnishVerma "Higher Engineering Mathematics", S.Chand publishing, 1st edition, 2011

MP SC – 2.4 TESTING OF MATERIALS & TRANSPORT PHENEMENON			
Subject Code	MP SC- 2.4	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03

Unit – I **10 Hours**

Testing of Materials: Introduction to material properties: Tensile Test: Load, Stress, deformation, strain, Hook's law, Young's modulus, stress-strain diagram. Engineering stress-strain curve, yield point, percentage elongation, percentage reduction in area, proof stress, universal testing machine, Typical stress-strain curves. Compression Test: Compression test on brittle and ductile materials, nature of failure. Shear; Tests: Shear stress, shear strain, Hook's law applied to shear stress and strain, Rigidity modulus, single shear test and double shear test. Torsion Test: Torsion in solid and hollow circular shafts, torsion equation and torsion test. Wear Test: Introduction to pin on disc method

Unit-II **10 Hours**

transport phenomenon: Hardness; Introduction, Micro Indentation Hardness, Brinnel hardness test, Vickers's hardness test, Rockwell hardness test, Rockwell superficial hardness test, Rebound hardness, shore's scleroscope. Impact Tests: Introduction, significance, Izod and charpy impact tests, effects of variables on impact test values. Fatigue: Introduction, Repeated loading, Fatigue strength and endurance limit, fatigue test, effect of variables on fatigue property. Testing of miscellaneous products: Introduction, testing of sheet, strip and pipes, ductility tests, bend test and reverse bend test, Testing of tubular products. Introduction to Non destructive testing; Visual examination, leakage testing, penetrant method, ultrasonic testing, X

Unit- III **10 Hours**

Fluid Mechanics: Fluid statics and its applications. Fluid flow phenomenon, Basic equations of fluid flow. Practical motion in fluids. Terminal velocity. Flow of incompressible fluids in conduits. Flow past immersed bodies. Transportation and metering of fluids.

Unit- IV **9 Hours**

Heat Transfer: Heat transfer by conduction in solids. Principles of heat flow in fluids. Heat transfer to fluids without phase change. Mass Transfer: Phase equilibria. Equilibrium stage operations. Leaching and extraction. Drying of solids. Gas absorption. Principles of diffusions and mass transfer between phases. Mass diffusion in liquids and solids. Convective mass transfer.

Reference books:

1. A.V.K. Surayanarayana - Testing of metallic materials
2. Martyn.S. Ray - The Technology and Applications of Engineering materials.
3. Thomus Curtney - Mechanical Behaviour of materials.
4. H.W.Hayden, W.G.Muffatt and John Wulff - The Structure and Properties of Materials.
5. R.S.Khurni - Strength of Materials.
6. B.S.Bhavikatti - Strength of Materials.
7. R.B.Bird - Transport Phenomenon
8. Kern - Heat Transfer
9. Traybal - Mass Transfer Operations
10. Mc Cabe & Smith - Unit operations of Chemical Engineering
11. Christic.J.Geankoplis - Transport Process & Unit Operations.

MP SC - 2.5 COMPUTER BASICS AND PROGRAMMING IN C & C++			
Subject Code	MP SC- 2.5	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03

Unit – I	**10 Hours**
Fundamentals of Computers: Organization of a computer, Parts of a personal computer, Input devices, Output devices, Computer storage devices.MS Office utilities, features, and facilities in MS Word, MS Power point. File handling, operations –opening, appending, cascading, closing and attribute control, storage and retrieval, sorting, merging, joining and dividing. Page layout formatting and editing.MS excel, data record, file, data structures, view, handling the data analysis and operations Data base concepts, operation, services, groups, tables graphs and objects. Measures of .dispersion. Statistical design of experiments, 1 and 2 way ANNOVA, Correlation coefficient and regression analysis, Linear and polynomial regression. Logarithm and sigmoid curves.	
Unit-II	**10 Hours**
Introduction to programming: Programming techniques, Algorithm, Flowchart. Fundamentals of C-language: Characters Used in C, Identifier, Keywords, Tokens, Constants, Variables, Variable declaration Basic Data types, Additional data types, Operators & Expressions, Additional operators, Structure of a C program Input /output Functions & Statements: Formatted Input/output functions, Escape sequences, Assignment statement, multiple assignment statement, writing user- friendly programs, Running a program using Turbo C	
Unit- III	**10 Hours**
Control statement in C: if –else statement, Nested if statement, switch statement ,Loop control structures in C: Loop control statements, for statement, Nested for statements, while statement, do-while statement, go to statement, break statement, continue statement' exit () function, nested for loop. Arrays and Subscripted Variables: One-dimensional array, Two-dimensional array, Array declaration. String manipulations in C: Reading /writing strings, String handling functions, Operations with characters. Pointers, Structures, Unions, enumerated data types, file handling, the C preprocessor, the C-standard library and header files. Introduction to Data Structures: Primitive and non primitive data types, Abstract data types, Definition and applications of Stacks, Queues, Linked Lists and Trees	
Unit- IV	**9 Hours**
Introduction to Object Oriented Programming : Introduction, Characteristics of object oriented programming, Data Types. Functions using c++, Concepts of object oriented programming: Classes and Objects, Inheritance, Types of Inheritance : Single, Multiple, Multilevel and Hybrid Inheritance, Polymorphism, Data abstraction, Overloading : Function Overloading, Operator Overloading and Templates.	

Reference books:

1. Srivastav - MS Office Complete
2. Udaya Kumar & Jeyapooyan - Computer Concepts & C-programming; 2008 Vikas Publishing
3. E.Balaguruswamy Programming in - C & C++,TMH 1990
4. Yashavant Kanitkar Publications - Understanding Pointers in C &C++BPB
5. Mullish Cooper - The Spirit of 'C' JAICO Publishing Hours
6. Bruce H.Hunter - Understanding 'C' BPB Pub. 1985

MP SC 2.6 HEAT AND MASS TRANSFER			
Subject Code	MP SC- 2.6	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**10 Hours**
Dimensional analysis and model testing: introduction, criteria of similitude .fundamental dimensions, Buckingham theorem, shear force in the flowing fluid. Frictional loss in pipes. Forced convection, natural or free convection. Advantages of dimensional analysis, Limitations of dimensional analysis physical significance of different non-dimensional numbers. Equivalent diameter. Model similitude			
Unit-II			**10 Hours**
Introduction to radiation: introduction. Basic theories of radiant heat transfer. Spectrum of electromagnetic radiation. Reflection absorption and transmission of radiation. Emission of radiation. Black body and monochromatic Radiation. Planck law of radiation. Total emissive power and Stefan Boltzmann law. Greybody and emissive power of greybody. Kirchhoff's law of radiation. Weins displacement law. Solid angle and intensity of radiation. Lambert cosine law radiation from real surfaces.			
Unit- III			**10 Hours**
Mass transfer: Introduction. Ficks law of diffusion .steady state diffusion of gases and liquids through solids. Equi molal diffusion. Isothermal evaporation of water into air. The mass transfer coefficient.			
Unit-IV			**9 Hours**
Thermometry: introductions. Fluid thermometers. Thermoelectric thermometers. Pyrometers. Possible errors in measurements.			

Reference books:

1. S.Domkundwar - A course in Heat & mass transfer
2. Jacob & Hawkins - Elements of Heat & mass transfer
3. ERG.Eckart & Robert,M - Heat nad Mass Transfer
4. Brown - Introduction to Heat Transfer

MPL HC- 2.7 ASSAYING LAB – I

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

MPL HC - 2.8 PETROLOGY LAB

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

MPL HC - 2.9 COMPUTER BASCIS -PROGRAMMING IN C & C++ LAB

Excel Math Basics: Writing Formulas and Expressions, Formatting Cells in Microsoft Excel , Locking Cells & Protecting Worksheets , Cell References in Microsoft Excel, Linking Worksheet Data in Excel, Microsoft Excel: Cool Keyboard Shortcuts , Using the Auto Fill Features of Excel, How to Create an Excel Chart , Chart Types: Pie, Column, Line, Bar, Area, ScatterCustomizing Charts: A Comprehensive Guide, ANOVAs [1 and 2 way], F-Test, t-Test, Moving Average, Exponential Smoothing . Correlation and Regression

Programs in 'C' involving (Turbo C++ IDE):

1. Constants, Variable, Data type and Evaluation of arithmetic expressions.
2. Input /output Functions & Statements
3. Control statement in C & C++.
4. Loop Control structures *for, while, do- while, switch, if, if-else*
5. Arrays, sorting, searching and matrices operations
6. String progressing
7. Use of Pointers, Structures and Recursive functions.
8. Classes & Objects, Inheritance, Polymorphism, Templates.

THIRD SEMESTER

MP HC - 3.1: ORE MICROSCOPY & RESEARCH METHODOLOGY			
Subject Code	MP HC- 3.1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I	**13 Hours**
Ore microscopy: Introduction to Ore Microscopy, Preparation of samples for Ore microscopic studies: Qualitative properties – Colour, Reflectance, Bireflectance and Reflection pleochroism. Isotropism and Anisotropism, Internal reflection, Rotation properties, Polishing hardness, Scratch hardness, Crystal form and habit, cleavage and parting, twinning etc.	
Unit-II	**13 Hours**
Quantitative properties – Micro indentation hardness and Reflectivity. Microchemical techniques, Modal analysis. Textures of Ore minerals, assemblages and paragenesis. Application of Ore microscopic studies in mineral technology	
Unit- III	**13 Hours**
Research methodology: Definition and nature of Research, Motivation and Creativity in Research, Different types and Styles of Research in Sciences. Scientific temperament. Critical and Positive thinking, Research plan and design. Topic and formulation of Infrastructure for Research proposal, Problem, Objectives and Scope. Collection of literature, Sources of Information in Mineral Processing – INSDOC service. Classification systems used in libraries, Use of catalogue cards	
Unit- IV	**13 Hours**
Preparation and presentation of research report for various publications. Presentation of illustrations, reprography services and Dissertation writing. Modern Information Technology: E-mail, CD-ROM, Fax, INFLIBNET, INTERNET. Use of Computers in Research. Art of reading, understanding and writing of Scientific Papers, Impact Factors and Citation Index. Plagiarism and Ethical values in Research	

Reference books:

1. E.N.Cameron - Ore Microscopy
2. J.R.Craig & Vaughan - Ore Microscopy and Ore Petrology
3. P.Ramdohr - The Ore Minerals and their Inter growths
4. A.S.Acharya - Guide to Thesis And Paper Writing
5. R.Ranganatha - Colon Classification
6. Henry & Sharp - Cataloging
7. M.N.Borse - Hand Book of Research Methodlogy.(Modern, Methods & New Technigues)
8. Deobold B.Van Dalen - Understanding Educational Research An Introduction

MP HC – 3.2 MINERAL PROCESSING - I			
Subject Code	MP HC- 3.2	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			13 Hours
Definition, Scope and necessity of Mineral Processing, Historical developments and Economics. Physical Properties of Ores and their importance in Mineral Processing. Sampling: Definition, purpose, types of sampling and measurements of accuracy of sampling. Definition of terms – Concentrate, Tailing, Middling, Recovery and Ratio of concentration. Unit operations. Simple problems on estimation of recovery and ratio of concentration. Efficiency and Selectivity index.			
Unit-II			**13 Hours**
Comminution: Definition and basic laws of Comminution, Simple problems on energy estimations. Crushing: Purpose, Mechanism of crushing, types of crushers and their salient features and maintenance of crushers. Grinding: Tumbling mills, Importance of cascading and cataracting, estimation of critical speed of tumbling mills. Types of tumbling mills, grinding practice, open and closed circuit grinding operations and related problems.			
Unit- III			**13 Hours**
Laboratory Sizing: Definition of particle size, measurement of particle size, Sizing by screening and sub- sieve sizing. Definition of sieve, screen, mesh. Advantages of wet and dry sieving. Graphical representation of size analysis data, size distribution functions and their applications. Industrial screens and their efficiency. Liberation: Definition, importance and application of ore microscopy in liberation studies and its analysis. Methods of liberation and behavior of locked particles			
Unit- IV			**13 Hours**
Movement of Solids in fluids : Free settling, Hindered settling , equal settling, Factors affecting the settling of particles, Laminar flow , Turbulent flow, Derivation of various laws , Reynolds number , Free settling ratio and Hindered settling ratio and numerical problems			

Reference books:

1. A.M.Gaudin - Principles of Mineral Dressing
2. S.K.Jain - Ore Processing
3. A.K.Lynch - Crushing and Grinding Circuits
4. B.A.Wills - Mineral Processing Technology
5. E.J.Pryor - Mineral Processing
6. A.F.Taggart - Text Book of Ore Dressing
7. A.F.Taggart - Hand Book of Mineral Dressing
8. A.M.Gaudin - Flotation
9. R.P.King - Flotation
10. Kelley & Spottiswood - Introduction to Mineral Processing
11. Robert.H.Richards, Charles Lock & R.Schumann - A Text Book of Ore Dressing
12. Pradeep & Rakesh Kumar - Selected Topics in Mineral Processing
13. S.P.Mehrotra & P.Sarkar - Mineral Processing – Recent advances and future trends.
14. A.Z.M. Abouzeid - Mineral Processing Laboratory Manual
15. S.Venkatachalam & Degaleeson - Laboratory Experiments in Mineral Processing
16. T.Allen - Practicle Size Measurement
17. A.K.Matis - Flotation Science and Engineering
18. A.K.Finch & G.S.Dobby - Column Flotation.

MP HC 3.3 COAL PREPARATION & FUEL TECHNOLOGY			
Subject Code	MP HC- 3.3	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I	**13 Hours**
Coal preparation: Scope, objectives and applications. Types and properties of coals in general, industrial uses, characteristics of coals, coking and non-coking coals. Washability studies, sink and float analysis of coals. Standard washability curves, tromp Curves, Mayer curves, probable error, washability index. Efficiency of coal washing.	
Unit-II	**13 Hours**
Gravity separation process**:** Jigging: jig types and applications. Comparision of mineral and coal jigs. Baum and Batac jigs. Heavy media Separation: Types, application and operation. Heavy Media (Commercial) , Media Recovery circuit. Heavy Media cyclones-operating principles ,applications, performance , efficiency and Design calculations. Preparation of non-coking coals. Fine coal washing : Modern trends. Froth flotation , Oil agglomeration , Water only cyclones and their applications in coal washing, Typical coal washing flow sheets with reference to Indian coal washeries, coal washery equipments and their selection. Factors of Designing a Modern coal washery.	
Unit- III	**13 Hours**
Fuel Technology: Scope, objectives, and applications. Types of fuels: solid, liquid, gaseous fuels with examples. Primary, secondary & tertiary fuels. Advantages of solid, liquid &gaseous fuels. Properties of fuels & their tests. Calorific value of fuels, Oxygen bomb calorimeter. Combustion of coal & their types. Boudouard reactions and other relevant reactions	
Unit- IV	**13 Hours**
Carbonization: Theory of carbonization, types of carbonization, advantages of carbonization, Gasification of coal, smelter gasifier and corex gas. standard metallurgical coke making process, properties of coke, Micum Test, Shatter Test, Haven test, Roga Index, Swelling Index, Gray king assay value, free swelling number. plastic properties of coals,High temperature properties of coke, byproducts of a coke oven, waste heat and flue gas recovery. Coal slurry injection to blast furnace	

Reference Books:

1. Osborne - Coal Vol. I and II
2. Michel - Coal
3. G.G.Sarkar - Coal Preparation
4. Wilfred Francis - Fuel Technology
5. Samir Sarkar - Fuel and ombustion
6. Samir Sarkar - Elements of Fuel
7. Samir Sarkar - Utilization of Coal
8. James G Speight Chemistry and Technology of Coal
9. Godfrey W.Humus - Fuel Technology
10. Wilfred Francis - Fuel Technology
11. James G Speight Chemistry and Technology of Coal
12. Bernard R Cooper and Willim A Ellingson The Science and Technology of Coal utilization
13. S. Venkatachalam& Degaleecan - Experiments in Mineral Engineering

MP SC - 3.4 SURFACE CHEMISTRY			
Subject Code	MP SC- 3.4	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Chemical Bonding: Ionic bond- Properties of Ionic solids, Covalent bond- Properties of covalent compounds, Polarity in covalent bonds, Hydrogen bond, Metallic bond.Colloids: Classification, Preparation, Properties and Application of colloids			
Unit – II			**10 Hours**
Adsorption: Types of adsorption and its characteristics. Thermodynamic models of isotherms. Fraundlich Adsorption Isotherm, Langmuir's Adsorption Isotherm, BET theory of multiplayer adsorption isotherm, Henry's law and Polany's potential theory, Mechanical effects of adsorption. Chemisorption			
Unit – III			**11 Hours**
Physical Chemistry of Surface and Interfaces: Liquid-Gas Interface: Surface tension and its measurement, Surface tension values, surface tension and temperature and other properties. Surface tension and chemical composition. Thermodynamics of surface tension, surface tension of solutions, Monolayers and their effects. Liquid-Liquid Interface: Interfacial tension and its values, Multicomponent system, Spreading of liquid over liquid, Films at interfaces, Emulsions. Solid-Liquid Interface: Interfacial energy, Stagnant layer at solid-liquid interfaces, Adsorption of liquids, Heat of wetting, Adsorption from solutions, Importance of adsorption and its utilization, Corrosion by liquids. Solid-Liquid-Gas Interface: Contact angle and its measurement and characteristics, Solid particles in liquid surface			
Unit – IV			**9 Hours**
Electrical characteristics on Interfaces: Static electricity, Conductance of solid-gas interfaces, Electrokinetic phenomenon, theory and its measurements, Effects of composition of liquid phases and solid on electrokinetic phenomenon. Electrical Double Layer, mutual repulsion of EDL's, utilization of electrokinetic phenomenon.			

Reference books:

1. O.Kubaschewski and C.B.Alcoc - Metallurgical Thermodynamics
2. Jan Leja - Surface Chemistry of Froth Flotation
3. Puri & Sharma - Principles of Physical Chemistry
4. Maron & Prutton - Principles of Physical Chemistry
5. Samuel Glasstone - Physical Chemistry
6. J.J.Bikerman - Surface Chemistry, Theory and Applications
7. Lloyd.I.Osipov - Surface Chemistry, Theory & Industrial Applications.
8. Duncan.J.Shaw Introduction to Colloid & Surface Chemistry.

MP SC - 3.5 INDIAN MINERAL DEPOSITS AND PLANT FLOW SHEETS			
Subject Code	MP SC- 3.5	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Importance of Mineral Resources for the Industry and Economy of a Nation. Mineral Resources, Expendable and Non-expendable minerals. Conservation of minerals. Metallic and non-metallic minerals, Essential, Critical and Strategic minerals.			
Unit-II			**11 Hours**
Study of important Metallic and Non-metallic Mineral Deposits of India with reference to Origin, Mode of occurrence, Mineralogy, Distribution, Production, Process Flow-sheets, Uses and Trades in India. Metallic deposits: Iron, Manganese, Chromium, Copper, Lead and Zinc, Bauxite, Gold and other precious metals			
Unit- III			**10 Hours**
Refractory minerals, Diamond, Beach sands. Minerals used in Glass, Cement and Ceramic industries. Minerals used in fertilizer industry, Minerals used as insulators, Structural and Building materials including Pigments and Fillers, Minerals used in chemical industry, Abrasive minerals, Industrial and manufacturing materials			
Unit- IV			**9 Hours**
Fuel Minerals: Oil and Gas, Coal & Lignite. Definition, Composition, types and Ranks of Coals, Macerals and Lithotypes and their distribution. Distribution and Mode of Occurrence of Radioactive Minerals			

Reference Books:

1. K.V.G.K.Gokhale & T.C.Rao - Ore Deposits of India
2. S.Krishnaswamy - Indian Mineral Resources
3. S.Deb - Industrial Minerals and Rocks of India
4. W.Seely & S.Mudd Serie - Industrial Minerals and Rocks
5. B.P.Radhakrishna - Mineral Resources of Karnataka
6. R.N.P.Arogyaswamy - A Course in Mining Geology
7. Roshan Bappu & Mular - Mineral Processing Plant Design
8. Weiss (Editor) S.M.E. - Hand Book of Mineral Processing Vol. I & II.

MP SC - 3.6: BIO PROCESSING			
Subject Code	MP SC- 3.6	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Concept and scope of bio-mineral processing. Utility of Microbes for beneficiation and selective dissolution of minerals/metals. Types of microbes & their genesis. Culturing and identification of microbes with reference to bio-processing. Acid mine drainage its impact and control. Bio-flotation and flocculation. Application of Bio-processing and dissolution			
Unit-II			**9 Hours**
Classification of microorganisms, Prokaryotic and Eukaryotic cells; general properties, distribution of microbes, applied fields of microbiology. Enumeration of microbes; microscopic techniques, staining. Bacteria - cell structure, spore, morphology, classification and reproduction. Culture characteristics, growth, nutrition requirements, morphology and reproduction of Fungi, Algae, Protozoa and Actinomycetes**.**			
Unit- III			**11 Hours**
Growth of microbes: batch culture, specific growth rate and doubling time; continuous culture; synchronous growth. Effects of environmental factors on growth. Microbial nutrition; culture media and culture characteristics. Handling of microbes; identification and staining. Control of microbes by physical agents and chemical methods. Microbial metabolisms - Anabolism/catabolism; Central metabolism: glycolysis and the TCA cycle; Metabolic pathways of contaminant biodegradation; Metabolic regulation Stoichiometry and Bacterial Energetic – Mass balances, Redox reactions: electron donor/electron acceptor; Redox half-reactions; Energy balances (_G) – Growth, Substrate Partitioning and theoretical yield, Electron acceptors, fermentation. Monod and Halden kinetics. Bio processing of sulphide ore (bio-leaching and bio-oxidation). Mineral bio-processing mechanisms; engineering process. Degradation of natural substances			
Unit- IV			**10 Hours**
Concept and principles of bio leaching . Eh-pH diagrams and their importance in prediction of leaching systems. Common metals extracted through bio leaching and bio hydrometallurgy. Characteristics of different microbes used in mineral processing, Direct and indirect attachment of microbes on mineral surfaces, Variation of surface charges in presence and absence of microbes, Use of microbes in mineral operations, Bio flotation, Bio flocculation some case studies. Microbes and their utility in bio hydrometallurgy. Isolation and identification of microbes used. Application of bio hydrometallurgy, some case studies			

Reference Books:

1. Agate. A.D. - Basic principles of Geo-Chemistry
2. Venkatechalam. S - Hydrometallurgy
3. Ehrlich, H.L. and Brierley, C.L Microbiological - Mineral Recovery
4. Karavaiko. G.I and Kaznetsor, S.I., - The Bactrial leaching of metals Iron Ores
5. Murr, L.E., Torma, A.E and Brierly. A.J. (eds) - Metallurgical applications of bacterial leaching and related microbiological phenomena.
6. Ross,G. - Biohydro - metallurgy.

MPL HC - 3.7: ORES AND ORE MICROSCOPY LAB
Study of metallic and non-metallic ores: - iron, manganese, copper, bauxite, lead and zinc ores etc., **Microscopic studies of ores –** Important textures, Refletance, Bireflectance, Microhardness andetch test.
MPL HC - 3.8: COMMINUTION AND CLASSIFICATION LAB
Sampling techniques and error estimation. Determination of physical characteristics of sample like specific gravity, bulk density, angle of repose. Size analysis, wet & dry sieve analysis, Sub-sieve analysis – Beaker decantation and Andreasen Pipette method, specific surface by permeability method, Verification of Gy's law. Determination of pulp density by actual, and specific gravity method [PD scale/tables]. Estimation of % solids both by weight and volume methods. Separation of sample by size and calculation of head and distribution of values. Recheck the actual by determinant methods. Crushing experiments – Jaw crusher, roll crusher. Verification of basic energy laws, Denver grindability test. Work index, Bond and HGI work index. Determination of terminal velocity - Free settling test, Hindered settling test, Cyclone test-rig demonstration experiments and classification [air and mechanical] experiments and performance of laboratory screening experiments
MPL HC - 3.9: ASSAYING LAB - II
Separation of elements by Ion Exchange and Solvent Extraction methods. Analysis of ores and Alloys. Experiments of Adsorption of liquids on solids.

FOURTH SEMESTER

MP HC-4.1: MINERAL PROCESSING - II			
Subject Code	MP HC- 4.1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I	**13 Hours**
Classification: Principles, Mechanism of classification, Types of sorting classifiers, Performance of hindered settling classifiers, Operation and efficiency of sorting hindered settling, classifiers as concentration devices and simple problems. Reflux classifiers, Stub cyclones, Autogenous media cyclones: Sorting classifiers; Principles, Operation and efficiency , types and their industrial application	
Unit-II	**13 Hours**
Introduction to Physical Methods of Separation: Principles, Types of processes and Ore characteristics. **Gravity Separation :** Separation in Vertical currents–Jigging–Theory and principles, differenttypes of jigs, operation of jigs, performance and efficiency, Jig circuits. Separation in Streaming currents – Theory of thin film concentration and flowing film concentration. Tabling- factors affecting the performance of tables, different types of tables. Spiral concentrators – principles, types of spirals, application of spiral concentrators, performance and their efficiency. Reichert cones, Enhanced Gravity concentration: Brief introduction of principles and operation – Multigravity separator, Floatex density separator, knelson concentrator, Falcon separator, Kelsey Jig, Apic Jig etc.	
Unit- III	**13 Hours**
Principles of magnetic separation, types of magnetic materials, different forces involved in dry and wet magnetic separation. Construction, operation and performance factors of different magnetic separators: Dry, wet, low and high intensity separators, drum separators, induced roll separator, cross belt separator, WHIMS, HGMS, etc. applications of magnetic separators.	
Unit- IV	**13 Hours**
Electrical Separation: Principles of electrostatic separation. Electrical properties of materials. Lifting and pinning effect, corona discharge. Construction, operation and performance factors of different electrical separators: high tension separators. Multi roll separator, plate and screen separators, tribo-electric separators. Applications of electrical separators. Auxiliary equipment and circuits for electrical separation. Dry methods of Beneficiation and Sorting: Principles, equipment and circuits.	

Reference Books:

1. Principles of Mineral Dressing - A.M.Gaudin.
2. Flotation - A.M.Gaudin.
3. Mineral Processing - E.J.Pryor
4. Text Book of Ore Dressing - A.F Taggart
5. Hand Book of Mineral Dressing - A.F Taggart
6. Will's Mineral Processing Technology - B.A. Wills

7. Introduction to Mineral Processing - Kelly and Spottiswood
8. Mineral Processing - S.K.Jain
9. Laboratory Experiments in Mineral Engineering - S.Venkatachalam & S.N.Degaleesan
10. Unit operations in Mineral Engineering - J.H.Brown
11. Mineral Processing Laboratory Manual - A-Z M Abouzeid.
12. Crushing and Grinding Circuits - A.J.Lynch
13. Flotation - R.P.King
14. A Text Book of Ore Dressing - Robert.H.Richards, Charles Lock &
15. R.Schumann Selected Topics in Mineral Processing - Pradeep & Rakesh Kumar
16. Mineral Processing – Recent advances - S.P.Mehrotra & P.Sarkar
17. future trends.
18. Practicle Size Measurement - T.Allen
19. Flotation Science and Engineering - A.K.Matis
20. Column Flotation. - A.J.Finch & G.S.Dobby
21. Flotation: Theory, Reagents and Testing R.D.Crozier
22. Flotation of sulphide Minerals K.S.E. Forssberg (Ed)
23. Developments in Mineral Processing Vol.6.
24. Surface Chemistry of Froth Flotation - Jan Leja
25. Reagents in Mineral Flotation - P.Somasundaran & Brij Moudgil
26. Operational Hand Book of Mineral Processing - V.V.Ramana Murthy

MP HC - 4.2: NON FERROUS EXTRACTIVE METALLURGY			
Subject Code	MP HC- 4.2	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Thermodynamics and kinetics of metallurgical reactions.Sources of Metals. Pyrometallurgy: Principles, Fuels and Combustion furnaces			
Unit-II			**13 Hours**
Unit processes of pyrometallurgy – Drying, Calcining, Roasting, Sintering, Smelting and Refining. Extraction of Copper, Nickel, Lead, Zinc, Aluminium, Gold, Silver, Titanium, Magnesium, Nuclear and Reactive metals. Use of Halides in non-ferrous extraction			
Unit- III			**13 Hours**
Hydrometallurgy: Principles, Chemical and Electrochemical Principles of Leaching, Precipitation, Solvent Extraction, Ion Exchange, Extraction, E_h -pH Diagrams, Metal Extraction under atmospheric pressure, high pressure and temperature. Extraction of metals-Gold, Silver, Uranium, Copper, Zinc and Nuclear metals. Bioleaching- Concepts and principles, E_h -pH Diagrams, Extraction of common metals, Microbes, Characteristics and utility			
Unit- IV			**13 Hours**
Electrometallurgy: Principles, Electrowinning and Electrorefining of metals like Copper, Nickel, Lead, Gold, Silver, Zinc etc., Electroplating. Powder Metallurgy: Principles and applications			

Reference Books:

1. Habashi.F., - Principles of Extractive Metallurgy. Vol I - IV
2. Kubaschewski.O., Erons.E.L., and Alcock, C.B. - Metallurgical Thermochemistry
3. Phelke. R.D., - Unit processing of Extractive Metallurgy
4. Rosenqvist.T., - Principles of Extractive Metallurgy
5. Newton.J., - Extractive Metallurgy
6. Gilchrist.J.d.Extraction Metallurgy
7. Bray.J.L., - Non-ferrous production Metallurgy
8. Ray.H.S., Sridhar.R. and Abraham.K.P., - Extraction of Non-ferrous Metals
9. Pryor.E.J.,- Mineral Processing
10. Kurt Meyer,_ Pelletization of Iron Ores
11. Venkatachalam.S., - Hydo-metallurgy

MP HC-4.3: MINERAL PROCESSING - III			
Subject Code	MP HC- 4.3	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Flotation fundamentals: Introduction, Classification of flotation machines and machine features. Physical aspects of Flotation – Surface Energy and surface tension, Interfacial tension, Cohesion, adhesion and Contact angle. Types of interfaces, Electrokinetic Phenemenon, Electrical Double Layer at the Solid-Liquid interface. Alteration of Solid surfaces caused by mechanical forces. Adsorption and its characteristics, pH, Solid/Liquid ratio. Micro flotation tests, Laboratory flotation tests, Flotation Kinetics and Factors affecting flotation			
Unit-II			**13 Hours**
Chemical Aspects – Flotation reagents and their Classification. Functions of each class of reagents. Dissociation and hydrolysis, Kraft point and Cloud point. Mechanism of Adsorption of reagents and Characteristics. Attachment of reagents to minerals as surface compounds, Attachment of reagents to Air bubble surface. Joint action of collectors and frothers. Mineralized froths and their stability. Types of flotation – Selective flotation, Skin flotation, Reverse flotation, Floc-flotation, Electro-flotation, ion flotation and Differential flotation.			
Unit- III			**13 Hours**
Introduction to dewatering and drying. Flocculation and Dispersion, principles of flocculation and dispersion phenomena. different types of flocculants used in dewatering techniques, selective flocculation and their applications. **Dewatering by gravity sedimentation**: Thickening principles and practices. Derivation of thickener diameter using Coe and Clevenger equation and Kynche Model. Design of a thickener, factors affecting thickeners operation and control. Different types of thickeners used in mineral industries such as conventional thickener (Bridge support and Column support type), Hi-rate thickener, lamella thickener, tray thickener etc., Dewatering Using Screens.			
Unit- IV			**13 Hours**
Filtration: Principles of filtration, factors affecting the filtration, different types industrial filters, cake filtration. **Centrifuging and drying**: Different types of thermal dryers and their application, centrifugal sedimentation. Application and practices of dewatering processes in mineral industries. **Tailing Disposal:** Tailing ponds and Design & construction, Types, Industrial applications and water reclamation			

Reference Books:

1. K.V.G.K Gokhale & T.C.Rao - Ore Deposits of India
2. A.M.Gaudin - Principles of Mineral Dressing
3. B.A.Wills - Mineral Processing Technology
4. S.K.Jain - Ore Processing
5. E.J.Pryor - Mineral Processing
6. A.F.Taggart - Text Book of Ore Dressing
7. A.F.Taggart - Hand Book of Mineral Dressing
8. Kelly & Spottiswood - Introduction to Mineral Processing
9. Robert.H.Richards,
10. Charles Lock & R.Schumann - A Text Book of Ore Dressing
11. Pradeep & Rakesh Kumar - Selected Topics in Mineral Processing
12. S.P.Mehrotra & P.Sarkar- - Mineral Processing – Recent advances and future trends
13. A.K.Lynch - Crushing and Grinding Circuits
14. A.M.Gaudin - Flotation
15. R.P.King - Flotation
16. A.K.Finch & G.S.Dobby - Column Flotation.
17. S.Venkatachalam & Degaleeson - Laboratory Experiments in Mineral Processing
18. A.Z.M. Abouzeid - Mineral Processing Laboratory Manual
19. T.Allen - Particle Size Measurement
20. A.K.Matis - Flotation Science and Engineering

MP SC - 4.4: MINERAL PROCESSING PLANT DESIGN – I			
Subject Code	MP SC- 4.4	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Sampling and Testing: Sampling a mineral deposit for feasibility studies and metallurgical testing. Metallurgical testing procedures. Metallurgical flow sheet development			
Unit-II			**11 Hours**
Selection and design features of Crushing and Grinding Equipments: Primary, Secondary & Tertiary Crushers. Rod and Ball mills. Autogenous grinding from Test work.			
Unit- III			**10 Hours**
Screening – Classification – Gravity Separation: Selection guidelines for size and types of Vibrating Screens in Ore crushing plants. Application and selection of Spiral Classifiers, Selection of cyclone classifiers. Pumps and pump boxes for grinding circuits			
Unit- IV			**9 Hours**
Process and plant design for gravity concentration – examples with flow sheets. Dense media separation. Metallurgical, Operating and Economic characteristics. Flow sheet development.			

Reference Books:

1. K.V.G.K Gokhale & T.C.Rao - Ore Deposits of India
2. A.M.Gaudin - Principles of Mineral Dressing

3. B.A.Wills - Mineral Processing Technology
4. S.K.Jain - Ore Processing
5. E.J.Pryor - Mineral Processing
6. A.F.Taggart - Text Book of Ore Dressing
7. A.F.Taggart - Hand Book of Mineral Dressing
8. Kelly & Spottiswood - Introduction to Mineral Processing
9. Robert.H.Richards,
10. Charles Lock & R.Schumann - A Text Book of Ore Dressing
11. Pradeep & Rakesh Kumar - Selected Topics in Mineral Processing
12. S.P.Mehrotra & P.Sarkar - Mineral Processing – Recent advances and future trends
13. A.K.Lynch - Crushing and Grinding Circuits
14. A.M.Gaudin - Flotation
15. R.P.King - Flotation
16. A.K.Finch & G.S.Dobby - Column Flotation.
17. S.Venkatachalam & Degaleeson - Laboratory Experiments in Mineral Processing
18. A.Z.M. Abouzeid - Mineral Processing Laboratory Manual
19. T.Allen - Particle Size Measurement
20. A.K.Matis - Flotation Science and Engineering

MP SC - 4.5: PROCESS CONTROL AND AUTOMATION			
Subject Code	MP SC- 4.5	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Introduction – Static performance characteristics, Dynamic characteristics – Transducer elements – Intermediate elements. Temperature – Temperature measurements, various methods – column change – softening type. Instruments on expansion concept. Resistance thermometers, Thermocouples – Radiation type pyrometers, Ionization principle – recent methods. Liquid level measurement – various types.			
Unit-II			**9 Hours**
Pressure – Pressure measurement – Manometers. Elastic properties utilization – Bourdon guage – Diaphragm guage. Force balancing concept. Bellow type – vaccum guage- McLead, Pirani Ionization gauge, High pressure measurements. Electrical type instruments. Density measurements – various types.			
Unit- III			**11 Hours**
Flow: Flow measurement, both weight and volumetric flow measurements. Usage of Bernoulli's principle – orifice plates, venturi, elbow flow meter, nozzle – weirs – notch rotameters, laminar flow meter, obstructionless flow meter – positive displacement type – vane type. Viscosity measurements: various methods, Rheometers, Moisture and humidity measurements, various methods. Conductivity meter – pH meter. Particle size measurement using Image analysis			
Unit- IV			**10 Hours**
Introduction to feed back control P, PI & PID controllers, Liquid level, mixing tank, interacting and non-interaction systems. Control of Crushing plants, wet grinding circuits, and Flotation columns: Control objectives, Disturbances, Sensing techniques, Case studies of various advanced automatic control systems for different mineral processing plants.			

Reference Books:

1. Curtis D.Johnson; 7th Edn - Process Control Instrumentation Technology
2. Jon Stenerson,2003 - Industrial Automation and Process Control
3. F.G.Sainsky - Process system and Control

MP SC - 4.6: INDUSTRIAL MANAGEMENT			
Subject Code	MP SC- 4.6	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Growth and concept of Industry: - Basic and scientific factory systems, types of ownership, Principles of management. Organization- Types of organizations, role of executives, elements of co-ordination Functions of management: Planning, organizing directing, co-ordination, controlling and decision making			
Unit-II			**9 Hours**
Personnel Management:- Functions of personnel management, recruitment, selection and training of Workers and supervisors. Production Management: - Plant location, layout of plants, depreciation and valuation of machinery, production planning and control. Quality productivity movement in India. Automation in India, its advantages and disadvantages. Functions of production control and planning control, material control.			
Unit- III			**11 Hours**
Marketing: Functions of marketing, Market research, sales, organizational planning, advertising and sales promotion, duties of sales personnel.			
Unit- IV			**10 Hours**
Human Relations: Job specification and morale, Employer and Employee relations, Health and Wealth of workers. Effects of physical conditions like noise, lighting, ventilation on output, fatigue and reduction of fatigue. Industrial safety: Accidents and their reduction. Settlement of individual disputes, ILO, workers participation in management.			

Reference Books:

1. Barthwal. B.R.Industrial Economics- An introductory Text Wiley Eastern Ltd., New Delhi, 1984.
2. Mehta.P.L. - Managerial Economics
3. Sultan Chand & Sons, New Delhi – 1988 Dwivedi - Text book of Managerial Economics
4. Vikas Publihsing House, New Delhi 1998 Minor.J.B. & Miner.M.G. - Personnel and Industrial Relations:
5. A Managerial approach Mac Millan Publihsing Co.1997 Promod Verma & Surya Mokkerjee - Trade Unions of India
6. Oxford & IBH Publishing Co. 1982 Banga.T.R. & Sharma.S.C. - Industrial Organisation and Engineering Economics Khanna Publications, Delhi

MPL HC - 4.7: GRAVITY AND MAGNETIC SEPARATION LAB
Sink and float tests, preparation of washability cuves and reduced efficiency [tromp] curves Demonstration Experiments in Jigging, Tabling, Spiral concentration. Performance analysis of Dry Magnetic separation / Wet Low Intensity / Wet High Intensity Magnetic Separation studies, Davies tube experiments, Laboratory Magnetic Amenability Studies.
MPL HC - 4.8: METALLURGY LAB Process diagnostic metallurgical tests, Experiments on Reduction and Oxidation roasting, Thermal decomposition, Leaching [aqueous, acidic, alkaline, oxidative, reductive and complexing] [heap, agitational] and Phase rule
MPL HC - 4.9: COAL PREPARATION LAB Sampling of coal, Study of washability curves, sink and float analysis. Preparation of Laboratory liquids, Study of washability index . Ash analysis, Proximate analysis of coal, Hard grove grindability index. calorific value of coals using oxygen bomb calorimeter. Study of typical Indian coal washery flow sheets. Solving of washability problems and other calculations. Experiments on Jigging, H.M.Separation, froth flotation and oil agglomeration of coal. Study of coking and non-coking coals. Carbonization of coking coals, experiment on classification of fine coal using cyclone.

FIFTH SEMESTER

MP HC - 5.1 ENVIRONMENTAL MANAGEMENT & MINERAL PROCESSING ECONOMICS			
Subject Code	MP HC- 5.1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03

Unit – I **13 Hours**

Introduction: Impact on environment and Ecology due to mining and mineral processing, Biosphere, Natural cycle, Concept of sustainable development, Life Cycle Assessment, Environmental Impact Assessment, Environmental management Plan, Objectives of Environmental Plan. Environmental pollution, definition of Pollution, Origin of Pollution, Pollutants, Classification of Pollutants, Types of Pollution, Source of Pollution, Effects of Pollution on the Environment

Unit-II **13 Hours**

Air Pollution: Introduction, composition of air, Origin of Atmosphere, Structure of Atmosphere, (Troposphere, Stratosphere, Mesosphere, Thermosphere, and Exosphere), Sources of Air pollution, Classification of Air Pollution and Pollutants-according to air origin and state of materials. Effects of Air Pollution (Effects on Human health, animals,Plants, material and climate).Air pollution laws, analysis of air pollutants, measurement of air quality, units, sampling devices and methods of sampling, control of air pollution and equipments

Unit- III **13 Hours**

Water Pollution: Characteristics of water, Types of water pollution, sources of water pollution, Classification of water pollutants, Waste water sampling and analysis, Waste water treatment, control of water pollution, water management – Industrial wastes and treatment processes. Soil pollution: Introduction to soil chemistry, soil pollution, soil erosion, control of land degradation, control of soil pollution- solid waste management. Soil pollution by Industrial wastes, Soil pollution - Chemical and metallic pollutants, Radioactive pollution. Soil pollution by industrial waste and remedial measures. Noise Pollution: Definition, Sources and Classification of Noise pollution, Measurement of Noise, Units of sound, Noise level, Measuring noise level, Industrial noise pollution, Prevention and control of noise pollution.

Unit- IV **13 Hours**

Role of mineral industry in National Economy. Economics- Definition, Wealth, cost, prices, Elements of economic activities – production and Productivity. Demand, Supply and Distribution of Income. Economic organization of industry, Private and Public sector, Costs and cost accounting. Capital interest and annual charges, obsolescence, depreciation and valuation. International Trade related to Mineral Industry. Economic selection of equipment, estimating the cost of equipment. Capital and operative cost. Milling calculations and Mill reports.

Reference Books

1. C.S.Rao - Environmental Pollution Control Engineering
2. Suresh K.Dhameja - Environmental Engineering and Management
3. M.N.Rao, H.V.N.Rao - Air Pollution

4. Fred & Bell - Environmental Geology, Principles and practices
5. Willium P.Cunningham and Barbara Wood worth Saigo - Environmental Science – A Global Concern
6. Herbert.F.Lund Industrial Pollution Control Hand book.
7. B.K.Sharma - Environmental Chemistry
8. Anil Kumar De - Environmental Chemistry
9. Amitava Bandopadhyay, N.G.Goswami P.Ramachandra Rao. - Environmental West management in Iron and steel Industries.
10. P.S.Jaiswal and Nistha Jaiswal - Environmental Law See Add-2003
11. Barthwal. B.R.Industrial Economics- An introductory Text Wiley Eastern Ltd., New Delhi, 1984.
12. Dwivedi Text book of Managerial Economics Vikas Publihsing House, New Delhi 1998.
13. Banga.T.R. & Sharma.S.C. - Industrial Organisation and Engineering Economics Khanna Publications, Delhi.

MP HC - 5.2 AGGLOMERATION AND CEMENT MAKING			
Subject Code	MP HC- 5.2	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Agglormeration: Principles, mechanisms and importance of size enlargement process. Sintering of iron ores: effect of fluxes, fuel and moisture content. Briquetting and Nodulizing			
Unit-II			**13 Hours**
Pelletization – principles, mechanisms, fundamental forces of cohesion between particles, surface tension, forces between microassemblies, pore size distribution, additives, pre-heating & indurations, quality of agglomerates, effect of parameters size, moisture, binder concentration, effect of drying and autoclave curing, fluxed pellets, composite pre -reduced pellets and cold bonded pellets. Compaction by piston/ roll press – effect of machine and material parameters			
Unit- III			**13 Hours**
Cement Making: Introduction to cement making, chemical composition and physical properties of raw materials, general types of Portland cement, special types of cements. Major components, critical impurities chemical analysis, raw material requirement and proportionating Types of process, product fineness, reclaiming and proportionating			
Unit- IV			**13 Hours**
Crushing and Grinding Circuits for raw materials, additives, beneficiation, operating costs. Mixing: - dry and wet processes. Burning and cooling: - chemistry of kiln process, kiln capacity, rotary kiln design, fuels, clinker cooling , kiln exhaust gas and dust handling systems. Cement storage and handling systems.			

References Books

1. H.S.Ray, R.Sridhar & K.P.Abraham Extraction of Non Ferrous Metals

2. T.Rosenqvist Principles of Extractive Metallurgy
3. H.S.Ray & A.Ghosh Principles of Extractive Metallurgy
4. R.H.Tupkari Introduction to Modern Iron Making
5. Lardinois, I., and Klundert, A van de Organic Waste – Options for Small-scale Resource Recovery, Urban Solid Waste Series, TOOL / WASTE Consultants, 1993
6. Franceys, R A guide to the development of on-site sanitation. WHO 1992
7. Karekezi, S. and Ranja, T Renewable Energy Technologies in Africa, AFREPEN, 1997
8. Vogler, Jon Work from Waste – Recycling Wastes to Create Employment, Intermediate Technology Publications, 1981. A classic text full of practical ideas for recycling and re-use of waste
9. Pollock, Cynthia Worldwatch paper – Mining Urban Wastes: The Potential for Recycling, Worldwatch Institute 1987
10. S.Ramachandra Rao (Ed) Waste processing and recycling in mineral and metallurgical industries Vol. II: proceedings of the International Symposium on Waste Processing and Recycling in Mineral and Metallurgical Industries II, Vancouver, British Columbia, August 20-24, 1995
11. A.F Taggart Hand Book of Mineral Dressing SME HAND BOOK OF MINERAL PROCESSING : vol I and II
12. Kurt Meyer Pelletising of Iron Ores

MP HC -5.3 FERROUS EXTRACTIVE METALLURGY			
Subject Code	MP HC- 5.3	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Iron Making: The blast furnace plant and its accessories. Raw material and their preparation. Sintering and Pelletization. Blast furnace reactions			
Unit-II			**13 Hours**
Modern trends in blast furnace practice – High top pressure, Oxygen enrichment of blast, Humidification of blast. Auxiliary fuel and lime dust injection through the tuyers. Laddle de-siliconization, External desulfurization. Direct reduction process – Rotary Kiln, Gaseous reduction (Hyl, Midrex), Electric Process (Pig Iron Tysland, hole process), Corex Technology			
Unit- III			**13 Hours**
Steel Making: Thermodynamics of refining – Carbon, Silicon, Manganese, Phosphorous and Sulphur reactions. Deoxidization of steel – Raw materials for steel making. Steel making by L.D.Process			
Unit- IV			**13 Hours**
Steel making by Oxygen bottom blowing and combined blowing. Other recent processes. Secondary steel making processes. Electric arc furnace process, Casting pit practice , continuous casting of steel, Production of ferro alloys			

References Books:

1. Biswas. A.K. Principles of Blast Furnace Iron making
2. Tupkary.R.H. Introduction to Modern Iron Making

3. Tupkary.R.H and Tupkary.V.R An Introduction to Modern Steel Making
4. Kurt Meyer Pelletising of Iron Ores
5. Ghosh.A and Chatterjee.A Iron making and Steel making
6. Ghosh.A. Text book of Material and Metallurgical thermodynamics

MP SC 5.4 MINERAL PROCESSING PLANT DESIGN – II			
Subject Code	MP SC- 5.4	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Flotation: Basic functions and sizing and Selection of flotation machines, Flotation machine families, Selection of chemical reagents, Conceptual design of flotation circuits			
Unit-II			**6 Hours**
Magnetic and Electrostatic separation: Types, Process and Plant design of Magnetic and Electrostatic separators. Flow sheets			
Unit- III			**9 Hours**
Solid-Liquid separation: Thickeners – Mill design for thickeners, thickener tanks, Mechanism of operation and control. Filters – Types and theory of continuous filtration, Concentrate drying, Handling and storage.			
Unit- IV			**15 Hours**
Belt conveyers: Design, Selection, Stackers and Reclaimers. Slurry transportation Operations: Design and Application of a Centrifugal slurry pump, Design and construction of Tailing ponds and water Reclamation facilities. Environmental considerations in mill sites. Dust collection systems – Electrostatic system design and Equipment applications. Design and construction of Modern Mineral Processing Plant and Flow Sheets			

Reference Books:

1. K.V.G.K Gokhale & T.C.Rao - Ore Deposits of India
2. A.M.Gaudin - Principles of Mineral Dressing
3. B.A.Wills - Mineral Processing Technology
4. S.K.Jain - Ore Processing
5. E.J.Pryor - Mineral Processing
6. A.F.Taggart - Text Book of Ore Dressing
7. A.F.Taggart - Hand Book of Mineral Dressing
8. Kelly & Spottiswood - Introduction to Mineral Processing
9. Robert.H.Richards, Charles Lock & R.Schumann A Text Book of Ore Dressing
10. Pradeep & Rakesh Kumar - Selected Topics in Mineral Processing
11. S.P.Mehrotra & P.Sarkar - Mineral Processing – Recent advances and future trends
12. A.K.Lynch - Crushing and Grinding Circuits
13. A.M.Gaudin - Flotation
14. R.P.King - Flotation
15. A.K.Finch & G.S.Dobby - Column Flotation.
16. S.Venkatachalam & Degaleeson - Laboratory Experiments in Mineral Processing
17. A.Z.M. Abouzeid - Mineral Processing Laboratory Manual
18. T.Allen - Particle Size Measurement
19. A.K.Matis - Flotation Science and Engineering

MP SC - 5.5 SIMULATION AND MODELING			
Subject Code	MP SC- 5.5	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**9 Hours**
Particle population and distribution functions: Distribution functions- Empirical distribution functions, Truncated size distributions, distribution density function, distribution by number, the representative size and population averages. Distributions based on particle composition, Joint distribution functions. Mineral liberation: beta distribution for mineral liberation.			
Unit-II			**9 Hours**
Size classification: Models based on screen capacity, Karra model and Kinetic Model. General principles of operation of the Hydrocyclone, Empirical performance models for hydrocyclones, The Plitt model for the hydrocyclone			
Unit- III			**11 Hours**
Comminution operations: Crushing machines, Jaw and gyratory crushers, Cone crushers, Crushing mechanisms and product size distributions. Magnetic separation machines, Dry Magnetic separation, Hopstock Model.			
Unit- IV			**10 Hours**
Flotation: A kinetic approach to flotation modeling, Pulp phase, Bubble phase, Froth phase, Entrained phase. A kinetic model for flotation, Particle–bubble collisions. Simplified kinetic models for flotation, Application to flotation cells in complex flow sheets			

References Book:

1. R.P.King; Butterwort Heinemann 2001 Modeling & simulation of Mineral Processing Systems
2. Bennette (Barrol) Particulate technology
3. PrasherGrinding Hand book

MP SC - 5.6: WASTE RECYCLING			
Subject Code	MP SC- 5.6	IA Marks	25
Number of Lecture Hours/Week	03	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
Unit – I			**11 Hours**
Mining wastes: Types of waste, utilization of waste dumps, separation of valuable metals from waste products of mining using primary separation methods, recovery of iron ore, manganese ore, coal and other ferrous metals from mining wastes, recovery of radioactive minerals from gold mining wastes, a case study of individual metal collection of mining waste model check dams and dumps			
Unit – II			**9 Hours**
Processing waste: Types of processing waste, waste slurry treatment using thickners , cyclones, sedimentation, settling techniques , solid waste recovery of valuable metals by simple separation methods, waste disposal , tailing dumps , ponds			

Unit- III	10 Hours
Metallurgical waste: Types of metallurgical waste, iron ore fines, coal fines, coke breeze, dolomite fines, sinter fines, pellet fines and sludge etc.Uses of fines in pellet plants , coke fines , sinter plants , briquette making & recycling using sinter plants Sludge, treatment , segregation and separation of sludge constituents using primary separation methods , iron ore , coke, and coal fines separation	
Unit- IV	**9 Hours**
Sludge: Sludge types, granulated slag reuse in cement plants. Sludge used in construction of roads and metal recovery from Sludge. Environment control and bio leaching techniques. Injection of iron ore and coke fines to blast furnaces and its advantages and disadvantages	

References Books:

1. McHarry, Jan, Reuse Repair Recycle, Gaia Books Ltd. 1993 A valuable source book aimed at reducing wastage by thrift. Aimed mainly at a western audience but with many references applicable to the developing world
2. Lardinois, I., and Klundert, A van de Organic Waste – Options for Small-scale Resource Recovery, Urban Solid Waste Series, TOOL / WASTE Consultants, 1993. The focus of this book is on the recovery of urban organic waste, in developing countries, through activities such as animal raising, composting, the production of biogas and briquetting
3. Franceys, R A guide to the development of on-site sanitation. WHO 1992. Provides in-depth technical information about the design, construction, operation and maintenance of on-site sanitation facilities, with numerous practical design examples.
4. Karekezi, S. and Ranja, T. Renewable Energy Technologies in Africa, AFREPEN, 1997
5. Vogler, Jon Work from Waste – Recycling Wastes to Create Employment, Intermediate Technology Publications, 1981. A classic text full of practical ideas for recycling and re-use of waste
6. Pollock, Cynthia Worldwatch paper – Mining Urban Wastes: The Potential for Recycling,
7. Worldwatch Institute 1987
8. S.Ramachandra Road(Ed) Waste processing and recycling in mineral and metallurgical industries Vol. II: proceedings of the International Symposium on Waste Processing and Recycling in Mineral and Metallurgical Industries II, Vancouver, British Columbia, August 20-24, 1995

MPL HC- 5.7: FLOTATION AND DEWATERING LAB

Thickening tests, selection of flocculants, Filtration vacuum and pressure filtration tests Preparation of material and metallurgical balance
Flocculation and dispersion. Oil agglomeration.
Experiments on Flotation – measurement of contact angle, surface tension and frothing, flotation of oxides, sulphides, salts and natural floatable minerals, differential flotation, flotation kinetics Circuit configuration, locked cycle test etc. Adsorption

MPL HC - 5.8: AGGLOMERATION

Pelletization studies : effect of size, moisture and binder concentration, drying, preheating and induration.

Sintering of iron ores – effect of fluxes, moisture and fuel. Roast sintering of pyrite concentrate. Compaction by piston / roll press.
Study of processing and development of flow sheets for Iron Ores, Manganese ores, Copper, Lead & Zinc ,Bauxite, Graphite, Limestone & Dolerite, Baryte, Magnesite and Clays.

NOTE : Each student should carry out experiments and develop flowsheets for any 3 of the above minerals.

MPL HC - 5.9: SIMULATION & MODELING LAB

Simulation Exercises using Ore Dressing Plant Simulator (e.g. MODSIM) on:

(Not less than 14 Exercises from the following)

1. Drawing Flow-sheet of Ore Dressing Plants
2. Simulation of crushing and grinding plants, Models for vibrating screens.
3. Simulation of gravity separation plants.
4. Dense medium separations - baths and cyclones.
5. Autogenous gravity separations - jigs, sluices, Riechert cones, water-only cyclones and spiral concentrators.
6. Simulation of flotation plants.
7. Models for flotation systems.
8. Comminution plants.
9. Models for SAG and FAG mills.
10. Models for ball and rod mills.
11. Models for classifiers.
12. Simulation of open and closed loop milling circuits.
13. Mineral liberation and comminution.
14. Simulation of combined comminution and concentration plants including regrinding.
15. Simulating complex plants.
16. Designing new plants.
17. Assessment of existing plants.
18. Calibration of models against plant data

SIXTH SEMESTER

MPHC 6.1 DISSERTATION	**08 Credits**
The student has to undertake a Project Work in the Department or in any well established Mineral based organization / laboratory for a period of 4 months and has to submit the dissertation report ***(The dissertation Certificates and the Format is attached as annexure I, II & III)***	
MPHC 6.2 VIVA-VOCE	**04 Credits**
The student has to face Viva-Voce examination and has to defend his dissertation thesis submitted	
MPHC 6.3 INDUSTRIAL TRAINING	---
After the completion of II and IV semester, the student has to undergo plant visit and industrial training respectively. The industrial visit report and industrial training report has to be submitted along with dissertation for evaluation.	
MPHC 6.4 INDUSTRIAL TOUR	---
During the V semester programme (III Semester Lateral Entry) , the students have to undertake the Industrial tour accompanied by 2 teaching faculty and 1 non teaching staff member for a period of 15 days. The detailed industrial tour report has to be submitted along with dissertation, industrial training reports for evaluation.	

SYLLABUS FOR OPEN ELECTIVE PAPERS

(FOR INTER-DEPARTMENT STUDENTS ONLY)

FOR II SEMESTER

MP OE1: STUDY OF MINERALS AND ROCKS			
Subject Code	MP OE 1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit – I			**13 Hours**
Mineral – Definition, Physical properties, Properties depending upon light, Cohesion and elasticity,Electrical conductivity, Heat and Magnetism. Classification of silicate and non-silicate minerals and their properties			
Unit-II			**13 Hours**
Rock- Definition, magma and its origin. Bowen's reaction principle, Classification of rocks. Processof formation of igneous rocks, structure and texture of igneous rocks. Origin and mode of occurrence of igneous rocks			
Unit III			**13 Hours**
Classification of sedimentary rocks, structure of sedimentary rocks. Process and formation of sedimentary rocks.			
Unit - IV			**13 Hours**
Definition of metamorphism, types and agents of metamorphism. Structure and texture of metamorphic rocks			

MP OE2: MINERAL RESOURCES OF INDIA			
Subject Code	MP OE 1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit –I:			**13 Hours**
Role of Mineral industry in National Economy. Strategic, critical and essential minerals. Renewable and non-renewable resources, Conservation of minerals, Metallic and non-metallic minerals. National Mineral policy			
Unit-II			**13 Hours**
Study of the following mineral deposits of India with reference to mineralogy, Mode of occurrence, distribution and production: Iron, Manganese Chromium, Copper, Bauxite and Gold			
Unit –III:			**13 Hours**
Study of minerals used in glass, cement, ceramic, fertilizer industries. Minerals used as insulators, minerals used in Chemical industry.			
Unit-IV			**13 Hours**
Abrasive minerals. Pigments and fillers, Fuels: Coal and Petroleum.			

FOR III SEMESTER

MP OE3: INTRODUCTION TO MINERAL PROCESSING			
Subject Code	MP OE 1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit –I			**13 Hours**
Definition, Scope and necessity of Mineral Beneficiation, Historical developments and Economics. Physical Properties of Ores and their importance in Mineral beneficiation. Definition of terms – Concentrate, Tailing, Middling, Recovery and Ratio of concentration. Unit operations. Sampling: Definition, purpose, methods, measurements of accuracy of sampling.			
Unit-II			**13 Hours**
Crushing: Purposes, Mechanism of crushing, types of crushers and their salient features. Grinding: Tumbling mills, Types of tumbling mills, open and closed circuit grinding operation. Liberation: Definition and importance of liberation studies and its analysis. Laboratory sizing, Industrial screens			
Unit –III:			**13 Hours**
Different techniques used in Mineral Processing –Brief study on Gravity Concentration,			
Unit-IV			**13 Hours**
Floatation, Magnetic Separation, Electro static Separation and Agglomeration			

MP OE4: IRON AND STEEL MAKING			
Subject Code	MP OE 1	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	52	Exam Hours	03
Unit- I:.			**13 Hours**
Iron Ore: Definition of ore, mineral, rock, gangue, tenor and grade of ore. Brief studies on Origin, occurrence and Distribution of iron ore deposits of the world, India, and Karnataka. Types of Iron Ores, Mineralogy of Iron Ore and banded iron formations, Liberation Studies			
Unit-II			**13 Hours**
Iron Ore Processing: Iron Ore washing, Gravity methods, jigging, H.M.S, Spiral, Classification, magnetic separation and flotation. Recent trends in iron ore processing including Iron Ore fines and slimes. Agglomeration of Iron Ore fines			
Unit-III			**13 Hours**
Iron Making: Raw Materials for iron making, Stoichiometry. Conventional blast furnace iron making, temperature profiles of blast furnace. Iron making, sponge iron making.			
Unit-IV			**13 Hours**
Steel Making: Raw materials for steel making, liquid iron refining. Impurities of liquid iron & and removal of carbon, silica, manganese, phosphorous, sulphur etc B.O.F.			

Annexure

GUIDELINES FOR REPORT WRITING

For

M.Tech (Mineral Processing)

(Dissertation & Seminar Report)

Applicable From Academic Year 2019 - 20

Department of Post Graduate Studies and Research in Mineral Processing

Vijayanagara Srikrishandevaraya University- Post Graduate Centre Nandihalli-Sandur

Phone No. Fax No.

Email-minerals@vskub.ac.in Web- www.vskub.ac.in

1.0 PREAMBLE:

The content and the way of presentation of the Project/Dissertation report shows the efforts taken by the candidate(s) for his/her work. Therefore, proper attention shall be paid to the content of Project/Dissertation report which is being submitted in partial fulfillment of the requirements of the respective degree and it is imperative that a standard format be prescribed for the report. This document provides guidelines and standard format forseminar/project/dissertation report writing of UG/PG programs and it may be referred as report writing guide. Some material in this document may be of use in the preparation of any technical report.

2.0 ORGANISATION OF THE REPORT:

The report shall be presented in number of chapters starting with introduction and ending with conclusion. Each of the chapters should have precise title reflecting the contents of that chapter. A chapter can be divided and subdivided into sections and subsections so as to present the content discretely and with due emphasis. In addition to main material of the report; preliminaries, references, appendices etc should be included in the report.

2.1. Sequence of Contents:

The material should be placed and bound in following order:

i) Preliminaries: The following information should be furnished in the given sequence.

Top Sheet of transparent sheet
Title page
Certificate
Declaration
Acknowledgement
Abstract
Table of Contents
List of Figures
List of Tables
Nomenclature
Acronyms if any

ii) The Chapters (Main material):

Itshall be presented in number of chapters starting with introduction and ending with conclusion as explained in section 4.

iii) Appendices:

iv) References:

v) Publications:

3.0 PRELIMINARIES:

3.1. Title Page:

It is a first page of report. Try to find a title that clearly describes the work you have done and be as precise as possible. MentionDissertation/ Project /

Seminar title your name, guide's (and co-guide's) name, name of the department name of the institute, place, month and year of the submission of report. **Refer page no 9**.

3.2. Abstract:

Summarize the main points of the report on a separate page. Persons interested in the report after reading the title should be able to judge from the abstract whether the report is really interesting for them. So, briefly formulate the problem that has been defined / investigated, the solutions derived, the results that have been achieved, and your conclusions. The abstract should not occupy more than one page (about 150 to 200 words). It must contain the context/ relevance of the problem at hand, a description of what was done and a gist of the significant observations/ results. It's noteworthy that the abstract shall be prepared after project work is over and report is completed in all respect. This page should precede the Table of Content page.

3.3 Certificate and Declaration:

Both pages shall be in the unique format provided with this guide and duly signed by student, guide and all the authorities with date. **Refer page no 10 and 11.**

3.4 Acknowledgement:

Please keep this brief and resist the temptation of writing floweryProse Do include all those who helped you, e.g. other faculty / staff you consulted, colleagues who assisted etc. Acknowledgement shall be included only in the final report and not in phase I or phase II as the case may be.

3.5 Table of Contents (ToC): Refer page no 11

- It should list items in the following order.

- Certificate (before Table of Content (ToC))
- Declaration (before T`oC)
- Acknowledgement (before ToC)
- Abstract (before ToC)
- List of figures (1.1, 1.2, 1.3.., 2.1, 2.2, .. etc.) (after ToC)
- List of tables (1.1, 1.2, 1.3.., 2.1, 2.2, .. etc.) (after ToC)
- Nomenclature (after ToC)
- Acronyms if any (after ToC)
- The chapters (1, 2, … N, followed by the name of the chapter),
  - Sections within chapters (e.g. 1.1, 2.4, etc. + name)
    - Subsections within sections (e.g. 1.1.1 + name)
- Appendices (I, II, III, IV, .. etc. + name), if any
- References
- Publications if any

- Do not include the table of contents itself in the ToC.

- Use borderless table for ToC

3.6 List of Figures and Tables:

Tables and figures should be numbered and captioned. Each table or figure should be numbered using a two-level scheme, (chapter no).(table no) or (chapter no).(figure no). This number (e.g. Table 4.8, or Fig. 3.7) should be used whenever the table/figure is referred in the text. Each table/ figure should have a title/caption. An identical entry should exist in List of Tables or List of Figures respectively. Title of a table is given at the top of the table preceded by its number. Caption of a figure is given at the bottom of the figure preceded by its number. Figures and tables should appear as close as possible to their first occurrence/mention in the running text of the chapter these belong to; these must appear after the first mention and not before. Photocopied tables should not be included. Photocopied figures should be avoided as far as possible and if included they should be large enough and clear. If taken from any reference, the reference should be cited within the text as well as at the caption of the figure or table.

3.7 Nomenclature:

It is necessary whenever symbols are used. This is in order of English (i.e. Roman) letters (Uppercase followed by lowercase), Symbols in Greek letters (see Appendix for the alphabetical order of Greek letters), subscripts and superscripts used, Special Symbols, followed by acronyms (i.e., Abbreviations) if any; everything in alphabetical order. All entries in nomenclature should have appropriate units in SI system.

3.8 Numbering of Report:

Every page of the report other than the title page should be numbered. Pages of Certificate, Acknowledgement, Table of Contents, Nomenclature, List of Tables and List of Figures should be numbered with lower case Roman numerals (i, ii, iii, iv, …etc.). From the first page of the first chapter onwards, all the pages should be numbered using Hindu-Arabic numerals (1, 2, 3, … etc.). The page numbers should appear at the bottom center as it is appearing in this document.

4 The Chapters:

The number of chapters you need and their contents strongly depend onthe topic selected and the subject matter to be presented. In general the following chapters may be included; however, it is your own report and you have to structure it according to the flow of overall logic and organization.

4.1 General Guidelines:

- Each chapter, section, subsection, etc. should have a title. An identical entry should exist in the ToC. Each chapter is numbered using Hindu-Arabic numerals: 1, 2, 3, ..
- Title with interrogative sentence should be avoided.

- The chapters may be structured in to sections and subsections. Sections within a chapter are numbered using a two-level scheme, (chapter no).(section no); for example, sections in chapter 3 are numbered 3.1, 3.2, ... Subsections within a section are numbered using a three-level scheme, (chapter no).(section no).(subsection no); for example, subsections in chapter 3, section 2 are numbered 3.2.1, 3.2.2, ... The sections and sub-sections must carry titles. Use different fonts for section titles and sub-section titles as specified in section 7.3.2 on page no 7.

- Presentation of your contributions should include formulation, derivations, description of experimental set-up, experimentaldata/measurements, designcalculations etc. For an experimental investigation, raw data must be available (preferably in an appendix). For aproject involving software development, user's manual, programmer'sanual, source code diskette/listing must be available. User's and programmer'smanuals are considered to be separate documents, distinctfrom your report.As mentioned previously, these could form appendices.

- The SI system of units should be used as far as possible.

- Results/ Discussion/ Comments: If there are too many aspects to be coveredthenorganize them in a logical manner.

4.2 Introduction:

In this chapter give introductory information about your project/dissertation/seminar and formulate the problem that you want to address the statement of a problem and its relevance, the initial goals you had, etc. without going into details. Here you also describe the structure of the rest of your report, indicating which chapter will address which issue.

4.3 Literature Survey:

It should be as exhaustive as possible but related to your work. The discussion on the literature may be organized under a separate heading & titled suitably. Summarize the literature that you have read. Rather than literally copying the texts that you have read, you should present your own interpretation of the theory. This will help you in developing your own thinking discipline and technical language. The last part of this section must contain a brief mention of the gaps in the literature and a justification for undertaking your study/project. Do not be too general. Avoid writing essays on historical developments.

4.4 Theory-Oriented Chapters:

The basic theory necessary to formulate the subject matter may be presented under this chapter & titled suitably.

4.5 Practice-Oriented Chapters:

Depending on the work that you have done, it might be important to write about the system specifications/design, practical details, system behavior and characteristics and cross links of the selected topic etc.(May be one or two chapters) eg Hardware Design, Software Development, Results and Discussion etc.

4.6 Conclusions:

This is one of the most important chapters and should be carefully written. It should be broadly divided as objective or introduction, conclusions and future scope. Here you evaluate your study, state which of the initial goals was reached and which not, mention the strong and weak points of your work, etc. You may point out the issues recommended for future research. State these clearly, in point-wise form if necessary, with respect to the original objective. Do not disguise "descriptions" of specific aspects, covered in the work as conclusions.

4.7 Equations:

Each equation should be numbered using a two-level scheme, (chapter no).(eq no). While typing, the equations should be centrally placed while equation numbers should be flush right. (LaTeX does this by default.) This number (e.g. 2.4, with 2 as chapter number and 4 as equation number) should be used (as Eqn. 2.4) whenever the equation is referred in the text. The equations should be clearly written. Symbols used in the equations should be explained immediately after the equation when they are referred first as well as in the nomenclature. SI units must be used throughout the report. Present equations in dimensionless form, wherever possible and appropriate.

4.8 Acronyms:

Avoid acronyms (short forms) in the report except the following standardones. Equation(s): Eq(s), Figure(s): Fig(s). The words 'Table' and 'Chapter' are not shortened. If any other acronyms have to be used, list them separately at the beginning (after nomenclature). Mention the acronym in the brackets following its full form, whenever it occurs first. The first word in a sentence shall never be a short form.

5.0The Appendices:

Appendices are useful for those things that you consider important,but that do not fit in the main presentation of your work and breaks the regular flow. There could be several reasons for using appendices: the material is too long and has too many details (e.g. the specifications of instruments or 4equipment), you have formulated a theorem, the proof of which is too long for the main text, you want to include a user manual for the software that you have come across (strongly recommended!), you want to present the schematics of a hardware design, experimental set-up, etc. Appendices tend to occupy many pages. Think carefully on what you want to include. For example, complete listings of the source code that you have written are seldom interesting. Instead, add a flow chart. Avoid describing the test set-up where a schematic can be easily used. Appendices are numbered as Appendix I, Appendix II, etc. or using capital English letters e.g. Appendix A, Appendix B, etc. If you have just one appendix, then it is not numbered. Alphabetical order of Greek letters: Alpha,

beta, gamma, delta, epsilon, zeta, eta, theta, iota, kappa, lambda, mu, nu, xi, omicron, pi, rho, sigma, tau, upsilon, phi, chi, psi, omega. Since reference can be drawn to published/unpublished literature in the appendices these should precede the reference (or Literature Cited) section.

6.0 References:

This should follow appendices, if any, otherwise the conclusion chapter. This chapter is also referred as "Literature Cited". Each entry in the reference has a label. All references cited in the text-body should be there in the Reference list and vice versa. Established acronyms may be used. e.g. AC, DC, ASME, ASTM, IIT, Jnl, etc., provided there is no likelihood of any confusion.

- **Labeling:** One of the following systems can be used for labeling the cited entries.

System 1:

A numeric label arranged in an order of citation in the main text. This label is used in square brackets or as superscript at the point of citation, e.g. [34]. The references should be arranged together in the order of this numeric label.

System 2:

A label derived from the authors name and the year of publication. For entries with 2 authors, include the surnames of both the authors followed by the year of publication. For entries with multiple authors, include the surnames of the first author followed by 'et al.' and the year of publication. This label is used in round brackets at the point of citation, e.g. (Taylor, 1982) or (Taylor et al., 1982) or (Taylor and Morgan, 1982).

- The references should be arranged together in the alphabetical order of the author surname (1st priority) and the year of publication (2nd priority).
- The reference list thus compiled together should be included after Appendices. In the reference list, you should provide the details of each entry in the following manner. These details differ depending on the type of bibliographic entry.

For a book:

name of the authors, title, publisher, city of publication and year of publication. (Taylor J. R., An Introduction to Error Analysis, Oxford University Press, Mill Valley, CA,USA, 1982

For an article in a journal:

name of the authors, title, name of the journal, volume (issue number), range of pages, and year. (Bandyopadhyay S., Bera N.C. and Bhattacharyya S., 'Thermoeconomic Optimization of Combined Cycle Power Plants', Energy Conver. Mgmt., 42(3), 359-371, 2001.)

For an article in conference proceedings: name of the authors, title, name of conference, editors (if present), range of pages and year. (Kedare S.B. 'Optics, Design, Performance and Economics of the Dynamic Fresnel Paraboloid Reflector Concentrator Dish

with Point Focus for High Temperature Solar Thermal Applications', Proceedings of National Renewable Energy Convention '99, Sawhney R.L. (Ed.), 9-15, 1999.)

- A chapter in a book: authors of the chapter, title of the chapter, editors of the book, title of the book, publisher, city of publication, range of pages, and year of publication.(Bilgen E., Industrial Solar Power Stations, Veziroglu T.N. (Ed.), Solar Energy and Conservation: Technology, Commercialization, Utilization, Volume2, Pergamon Press, NY, USA, 665- 673,1978)

- A report: authors, title, university/company, report number, year. (Ahmed K., Renewable Energy Technologies, World Bank Technical Paper Number 240, 1994)

- A Ph.D. or Masters Thesis: author, title, department, university, year. (Kedare S.B., 'Investigations on a Reciprocating Wind Machine', Ph.D. Thesis, Dept. of Mechanical Engineering, IIT, Mumbai, 1991)

- A manual / handbook / standards : company name (if there are no authors), title, reference number, year. (British Standards Institution, Specification for Steel girder bridges, BS153 : Parts 3B & 4 : 1972, 1972)

- A web-site : Author or Organization, name of the site, complete address of the site, date visited (Danish Wind Industry Association, Aerodynamics of Wind Turbines: Lift, http://www.windpower.org /tour/wtrb/lift.htm, Aug 16, 2002)

- **Bibliography:** In a few exceptional cases, it is useful to suggest a list of publications for background reading. These are not cited anywhere in the text. This list can be included as 'Bibliography'. It should follow 'References' on a fresh page.

7. Binding: The report shall be hard cover bound in leather or rexin **(Blue colour for M.Tech and Black for PhD.,).** The front cover shall be same as top cover page and all lettering shall be embossed in gold. In addition, emboss the title of project/dissertation/seminar, name of programme and month & year of submission on side strip of the report. At the time of final submission,

7.1 Submission: Students shall follow the following guidelines for final submission.

- First, get draft copy of your report approved and certified by your guide and HoD.
- Submit only one copy per group of above report in spiral binding form to the Principal through HoD of your department on or before due date.
- Once the report is approved by the Chairman/Guide then submits 4 number of copies of final report in hard bound form.

- **Instructions for Top Cover/Title Page**

1. **Title of dissertation/project/seminar:** All letters capital, font size - 18, Bold, centrally aligned
2. **Name of the programme, student,guide, department and college** : All letters capital, font size - 12, Bold, centrally aligned
3. **Matter, designation, examination number:** Title case, font size - 12, Bold. Examination number may not be specified on cover page.

4. Do not write designation of guide on top cover/title page.

- **Instructions for Certificate Page**

1. **College Name:**All letters capital, font size - 14 , Bold, centrally aligned
2. **Name of the department:** Title case, font size - 12 , Bold, centrally aligned
3. **Certificate:** All letters capital, font size - 12, Bold, Underlined, centrally aligned
4. **Title of Dissertation/Project/Seminar:** All letters capital, font size - 12, Bold.
5. **Name of student:** All letters capital, font size - 12, Bold.
6. **Name and designation of guide, HoD, Principal :** Title case, font size - 12
7. **Matter :** Title case, font size - 12, Bold.

- **Instructions for Declaration Page**

1. **Declaration:**All letters capital, font size - 14 , Bold, centrally aligned
2. **Title of Dissertation/Project/Seminar:** All letters capital, font size - 12, Bold
3. **Name of student:** All letters capital, font size – 12
4. **Name and designation of guide:** Title case, font size - 12 ,
5. **Matter:** Sentencecase, font size – 12. (Don't write exam/roll no on this page.)

GUIDELINES FOR DISSERTATION/ SEMINAR REPORT WRITING

Appendix I Format for TOP COVER/TITLE PAGE:
Hardbound reports should have the following printed/embossed on the cover:
Also the same is to be repeated as first page within.

TITLE

M.Tech DISSERTATION

Submitted to
Department of Post Graduate Studies and Research in Mineral Processing
In Partial Fulfillment of the Requirements for
The Degree of Master of Technology
In
Mineral Processing.

By
Candidate Name
(Reg Number)

Guide
"Guide Name"

DEPARTMENT OF POST GRADUATE
STUDIES AND RESEARCH IN MINERAL PROCESSING
MAY 2013

Appendix II Format for CERTIFICATION PAGE

CERTIFICATE

College Logo

This is to certify that the project/ dissertation entitled, **"Title of report"**, which is being submitted herewith for the award of M.Tech in Mineral Processing is the result of the work completed by **Student Name** under my supervision and guidance and the same has not been submitted elsewhere for the award of any degree.

(Prof.) (Name)

Gudie Head of Department

Examiner
l

Appendix III Format for DECLARATION PAGE

DECLARATION

I hereby declare that the project/ dissertation entitled, **"Title "** was carried out and written by me/ us under the guidance of Prof. , Professor, Department of Post Graduate Studies and Research in Mineral Processing, VSKUB PG Centre Nandihalli. This work has not been previously formed the basis for the award of any degree or diploma or certificate nor has been submitted elsewhere for the award of any degree or diploma.

Place:
Date:

Appendix IV Format for Table of Contents

CONTENTS

Appendix V Format for List of Figures and Tables

LIST OF FIGURES

LIST OF TABLES

Note: List of Figures and List of Tables shall de on separate pages.

M.Tech (Mineral Processing) CBCS Programme syllabus for regular 6 semester and 4 semester lateral entry is effective from the year 2019-20. The syllabus was scrutinized and recommended in BOS in Mineral Processing held on 07.03.2019, at the Department of Studies and Research in Mineral Processing VSKU Post Graduate Centre, Nandihalli-Sandur; by the following BOS members

Name	Designation	Signature with Date
Prof. S.J. Gopalkrishna	Chairman BOS	07/03/2019
Prof. P.C. Naganoor,	Member	
Prof. M.R. Patil	Member	7/3/19
Dr. P. Sharathkumar	Member	7.3.19
Prof. C. Venkataiah'	Member	7/3/19
Prof. M.D. Khanadali	Member	7/3/19
Prof. G. Chandrakanth Dept. of Applied Geology Kuvempu University, Shivamogga	External Member	7/3/2019
Prof. M. Aruna Dept. of Mining Engineering, NITK Surathkal	External Member	7/3/2019