SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE:EPABX–2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग ०२३१–२६०९०९४

Estd. 1962
"A++" Accredited by
NAAC(2021)
With CGPA 3.52

जा.क्र.शिवाजी वि./अमं/732 दिनांक. 09/10/ 2023

प्रति,

मा. अध्यक्ष व सदस्य,
सर्व अभ्यास/अस्थायी मंडळे (सायन्स)
शिवाजी विद्यापीठ, कोल्हापूर

विषय :– शैक्षणिक वर्षे 2023–24 पासून एम.एस्सी. अभ्यासक्रमाच्या आराखडया (Structure) बाबत.

महोदय/महोदया,

उपरोक्त विषयास अनुसरून आदेशान्वये कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण, 2020 ची राज्यातील अंमलबजावणीच्या अनुषंगाने विद्यापीठ अधिकार मंडळाच्या निर्णयानुसार शैक्षणिक वर्षे 2023–24 पासुन एम.एस्सी. अभ्यासक्रमासाठी सोबत जोडलेला कॉमन आराखडा **(Structure)** व **Formatting (Templet)** लागू करण्यात आले आहे याची नोंद घ्यावी.

सदरची बाब सर्व शिक्षक, विद्यार्थी व संबंधीतांच्या निदर्शनास आणावी.

कळावे,

आपला विश्वासू

(डॉ. एस. एम. कुबल)
उपकुलसचिव

प्रतः–

प्र.अधिष्ठाता विज्ञान व तंत्रज्ञान विद्याशाखा
मा.संचालक परीक्षा व मुल्यमापन मंडळ
परीक्षक नियुक्ती विभाग–1,2
सर्व परीक्षा विभाग (ऑन)
माहितीसाठी व पुढील योग्य त्या कार्यवाहीसाठी.

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दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९३/९४

SU/BOS/Science/499 **Date: 10/07/2023**

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.

Subject: Regarding syllabi of **M.Sc. Part-I (Sem. I & II) as per NEP-2020** degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-I (Sem. I & II) as per NEP-2020 degree programme under the Faculty of Science and Technology.

M.Sc.-Part I (Sem. I & II) as per NEP-2020			
1.	Microbiology (HM)	10.	Data Science
2.	Pharmaceutical Microbiology (HM)	11.	Computer Science
3.	General Microbiology	12.	Information Technology (Entire)
4.	Electronics	13.	Food Science & Technology
5.	Embedded Technology	14	Food Science & Nutrition
6.	Geology	15.	Biochemistry
7.	Sugar Technology (Entire)	16.	Biotechnology
8.	Alcohol Technology (Entire)	17.	Medical Information Management
9.	Agro Chemical & Pest Management (AGPM)	18.	Environmental Science
		19.	Physics

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in**)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Geology)

under
Faculty of Science and Technology

(To Be Implemented From Academic Year 2023-24)

INDEX

1.PREAMBLE:-

The revised syllabus includes the foundation, core and applied components of the course/paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.

2.DURATION:

- The course shall be a full time course.
- The duration of course shall be of Two years / 4 Semesters.

3. ELIGIBILITY FOR ADMISSION:- B. Sc. in Geology.

For Level 8 (Part I):

Completed B.Sc. (Level 7) with Geology as principal / major subject.

For Level 9 (Part II):

(i) Completed Post Graduate Diploma (Level 8) in Geology or

(ii) Completed Bachelor's Degree (Honours / Research) (Level 8) in Geology

4. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

5. Programme Structure:

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Geology) Part – I (Level-8.0)

SEMESTER-I (Duration- Six Month)											
Course Type	Sr. No.	CourseCode	Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Major Mandatory	1	MMT101	4	4	4	80	32	3	20	8	30 min
	2	MMT102	4	4	4	80	32	3	20	8	30 min
	3	MMPR 103	4	8	4	100	40	6	-	-	-
Major Elective	4	MET104/105	4	4	4	80	32	3	20	8	30 min
	5	MEPR106/107	2	4	2	50	20	3	-	-	-
Research Methodology	6	RM108	4	4	4	80	32	3	20	8	30 min
TOTAL (A)			--	28	**22**	**470**	--	--	**80**	--	--
SEMESTER-II (Duration- Six Month)											
Major Mandatory	1	MMT201	4	4	4	80	32	3	20	8	30 min
	2	MMT202	4	4	4	80	32	3	20	8	30 min
	3	MMPR 203	4	8	4	100	40	6	-	-	-
Major Elective	4	MET204/205	4	4	4	80	32	3	20	8	30 min
	5	MEPR206/ 207	2	4	2	50	20	3	-	-	-
OJT/FP	6	OJT/FP208	4*	4*	4	60	24	3	40	16	*
TOTAL (B)			--	--	**22**	**450**	--	--	100	--	--
TOTAL (A+B)			--	--	**44**	**920**	--	--	**180**	--	--

• Student contact hour per week: 28 Hours (min.)	• Total Marks for M. Sc. - I : **1100**
• Theory lectures 60 minutes Each and Practical lectures 120 minutes each.	• Total credits for M. Sc. - I (Semester I &II): **44**

•MMT- Mandatory Theory Course •MMPR- Mandatory Practical Course •MET- Elective Theory Course •MEPR- Elective Practical Course •RM- Research Methodology •OJT/FP- On Job Training/ Field Project (**during vacation)	• Theory and Practical examination will be conducted at the end of respective semester. • Practical courses may be divided into sub-sections. • UA: University Assessment • IA: Internal Assessment • ***Separate passing is mandatory for Theory, Internal and Practical Examination***
• **Requirement for Entry at Level 8: Completed all requirements of the Bachelor's Degree (Level 7) with Geology as principal / major subject.**	
• **Exit Option at Level 8: Students can exit after Level 8 with Post Graduate Diploma in Geology if he/she completes the course equivalent to minimum of 44 credits.**	

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Geology) Part – II (Level-9.0)

SEMESTER-III
(Duration- Six Month)

Course Type	Sr. No.	CourseCode	Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Major Mandatory	1	MMT301	4	4	4	80	32	3	20	8	30 min
	2	MMT302	4	4	4	80	32	3	20	8	30 min
	3	MMPR 303	4	8	4	100	40	6	-	-	-
Major Elective	4	MET304/305	4	4	4	80	32	3	20	8	30 min
	5	MEPR306/307	2	4	2	50	20	3	-	-	-
Research Project	6	RP308	4	4	4	80	32	3	20	8	*
TOTAL (A)			--	28	**22**	**470**	--	--	**80**	--	--

SEMESTER-IV (Duration- Six Month)											
Major Mandatory	1	MMT401	4	4	4	80	32	3	20	8	30 min
	2	MMT402	4	4	4	80	32	3	20	8	30 min
	3	MMPR 403	4	8	4	100	40	6	-	-	-
Major Elective	4	MET404/405	4	4	4	80	32	3	20	8	30 min
	4	MEPR406/ 407	2	4	2	50	20	3	-	-	-
Research Project	5	RP408	4	4	4	80	24	3	20	8	*
TOTAL (B)			--	--	**22**	**470**	--	--	80	--	--
TOTAL (A+B)			--	--	**44**	**940**	**--**	**--**	**160**	**--**	**--**

• Student contact hour per week: 28 Hours (min.)	• Total Marks for M. Sc. - II : **1100**
• Theory lectures 60 minutes Each and Practical lectures 120 minutes each.	• Total credits for M. Sc. - II (Semester III &IV): **44**
•MMT- Mandatory Theory Course •MMPR- Mandatory Practical Course •MET- Elective Theory Course •MEPR- Elective Practical Course •RP- Research Project	• Theory and Practical examination will be conducted at the end of respective semester. • Practical courses may be divided into sub-sections. • UA: University Assessment • IA: Internal Assessment • ***Separate passing is mandatory for Theory, Internal and Practical Examination***
• **Requirement for Entry at Level 9:** **1) Completed all requirements of the relevant Post Graduate Diploma (Level 8) in Geology.** **2) Bachelor's Degree (Honours / Research) (Level 8) in Geology.**	
• **Exit Option at Level 9: Students can exit after Level 9 with Master's Degree in Geology if he/she completes the course equivalent to minimum of 88 credits.**	

6. Programme Outcomes (POs)

After completing the post graduation in the faculty of Science, the student is expected to have:

- Explain scientific laws and principles and applies the scientific knowledge to overcome complex problems in the life.
- Elaborate nature, environment and society critically and rationally.
- Give explanation terms, facts, concepts, processes, techniques, and principles of subjects.
- Communicate the scientific knowledge in lingua-franka of the world i.e. English and gain access to the current scientific affairs.
- Enlighten the people around by uncovering the scientific principles behind the magic and superstitions.
- Show sensitivity to the matters of environment sustainability and use science for the progress of humanity without damaging the ecosystem.
- Self employable abilities through consultancies.

7.Course Codes:

M.Sc. Semester-I		
1	Mineralogy, Optics and Crystallography(4 credit)	**MSU0325MML921G1**
2	Igneous Petrology(4 credit)	**MSU0325MML921G2**
3	Practical Lab-I (4 credit)	**MSU0325MMP921G1**
4	Practical Lab-II (2 credit)	**MSU0325MMP921G2**
5	Research Methodology (4 credit)	**MSU0325RML921G**
6	Stratigraphy and Palaeontology(4 credit)	**MSU0325MEL921G1**
	Remote Sensing and Geomorphology(4 credit)	**MSU0325MEL921G2**

M.Sc. Semester-II		
1	Metamorphic Petrology(4 credit)	**MSU0325MML921H1**
2	Sedimentary Petrology(4 credit)	**MSU0325MML921H2**
3	Practical Lab-III (4 credit)	**MSU0325MMP921H1**
4	Practical Lab-IV (2 credit)	**MSU0325MMP921H2**
5	Field Project/OJT (4 credit)	**MSU0325FPP921H/ MSU0325OJP921H**
6	Geophysics and Exploration Methods(4 credit)	**MSU0325MEL921H1**
	Mining Geology(4 credit)	**MSU0325MEL921H2**

COURSE STRUCTURE :
M. Sc. GEOLOGY PART-I (LEVEL-8)

Sr. No.	Course Code	Course Title		Credits
SEMESTER I				
1	MMT101	Mineralogy, Optics and Crystallography		4
2	MMT102	Igneous Petrology		4
3	MMPR103	Practical based on MMT101 and MMT102		4
4	MET104/105	Any one of the following elective papers		4
		MET104	Stratigraphy and Palaeontology	
		MET105	Remote Sensing and Geomorphology	
5	MEPR106/107	Practical based on MET104/105		2
6	RM108	Research Methodology		4
SEMESTER II				
1	MMT201	Metamorphic Petrology		4
2	MMT202	Sedimentary Petrology		4
3	MMPR203	Practical based on MMT201 and MMT202		4
4	MET204/205	Any one of the following elective papers		4
		MET204	Geophysics and Exploration Methods	
		MET205	Mining Geology	
5	MEPR206/207	Practical based on MET204/205		2
6	FP/OJT208	Field Project/On Job Training (During Summer Vacation)		4
			Total Credits	44

COURSE STRUCTURE :
M. Sc. GEOLOGY PART -II (LEVEL-9)

Sr. No.	Course Code	Course Title		Credits
SEMESTER III				
1	MMT301	Hydrogeology		4
2	MMT302	Geochemistry		4
3	MMPR303	Practical based on MMT301 and MMT302		4
4	MET304/305	Any one of the following elective papers		4
		MET304	Natural Resource Management	
		MET305	Environmental Geology	
5	RP308	Research Project		4
6	MEPR306/307	Practical based on MET304/305		2

SEMESTER IV				
1	**MMT401**	**Economic Eeology**		**4**
2	**MMT402**	**Structural Geology and Geotectonics**		**4**
3	**MMPR403**	**Practical based on MMT401 and MMT402**		**4**
4	**MET404/405**	**Any one of the following elective papers**		**4**
		MET404	**Engineering Geology and Geotechniques**	
		MET405	**Geoinformatics**	
5	**MEPR406/407**	**Practical based on MET404/405**		**2**
6	**RP408**	**Research Project**		**4**
			Total Credits	**88**

8. Syllabus:

M. Sc. Part – I: Geology

Semester I

Title of Course: MMT-101: Mineralogy, Optics and Crystallography

Course Code: MSU0325MML921G1

Total Credits: 04

Unit I

Atomic structure; Bonding in minerals; Mineral stability; Ionic radii; Co-ordination polyhedra; Pauling's rule; Ionic substitution; Solid solution; Fluid inclusions-formation, composition and importance; Partitioning of elements between melt and silicates

Systematic study of the following common rock forming mineral groups with reference to their structure, chemical composition, physical-optical properties and paragenesis: Olivine, Pyroxene, Amphibole, Mica, Feldspar, Silica, Alumino-silicates, Garnet, Feldspathoids, and Zeolites.

Unit II

Properties of light, interference of light waves, Concept of plane polarized and cross polarized light, Behavior of light under petrological microscope, Optical properties of minerals, Measurement of Refractive Index.

Conoscopic light, Accessory plates, Concept of uniaxial and biaxial indicatrix, Interference figure, Determination of optic sign of uniaxial and biaxial minerals, Optic orientation in different crystallographic systems, Measurement of birefringence,

Unit III

Space lattice, Unit cell and space group / point group, 32 classes of symmetry,

Unit IV

Goniometry, Crystal projections- spherical, stereographic and goniometric, Twinning, Irregularities and imperfections of crystals.

Analytical methods in mineralogy - Introduction to Multiple differential thermal analysis, Electron microscope analysis, Scanning and transmission electron microscopy, Electron-Probe Micro-Analysis (EPMA), Cathodoluminiscence , thermoluminescence and X ray diffraction method.

Reference Books

1. Textbook of Mineralogy: E. S. Dana.
2. Elements of Mineralogy: Berry Masson.
3. An Introduction to Rock Forming Minerals: W. A. Deer, R. A. Howie and J. Zussman.
4. Rock Forming Minerals, Volumes 1 to 5: W. A. Deer, R. A. Howie and J. Zussman; Longman
5. Optical Mineralogy: Paul F. Kerr.
6. Optical Crystallography: E. E. Wahlstrom.
7. Optical Mineralogy: U. M. Revell, Phillips and Dana, T. Griffien; CBS Edition.
8. A practical Introduction to Optical Mineralogy: C. D. Gribble, A. J. Hall.
9. An Introduction to Crystallography: Phillips
10. Minerals and Rocks: Exercises in Crystallography, Mineralogy, and Hand Specimens: Corneis Klein
11. Manual of Mineralogy: Klein, C. and Hurlbut, Jr.CS.; John Wiley.
12. Gemstones Enchanting Gifts of Nature: Dr.Karanth Geological Society of India, Banglore, Publication.
13. Crystals and their structure: Cracknell .
14. Modern Mineralogy: Frye Keith.

M. Sc. Part – I: Geology
Semester I

Title of Course: MMT-102: Igneous Petrology
Course Code: MSU0325MML921G2
Total Credits: 04

Unit I

Magmatism and Plate Tectonics, Physical properties of magma- geothermal gradient, heat source, Present day igneous activity. Use of rare earth elements in determining the source of magma.

Textures and structures of igneous rocks, Classification of igneous rocks and their tectonic significance. Norms-CIPW and Niggli values, Zavaritskii number, TAS diagram. IUGS classification of plutonic and volcanic igneous rocks: QAPF diagram, classification of Mafic and UltraMafic igneous rocks, Potassic igneous rocks, melilitic rocks, lamprophyres and carbonatites.

Unit II

Crystallisation of magma, Magmatic differentiation, and Assimilation, Role of volatiles, Variation diagrams and differentiation indices (Harker's diagram, mg number etc.) and their significance.

Phase equilibrium of single, binary, ternary and quaternary silicate system, Study of binary and ternary systems: Albite-Anorthite system, Forsterite-Silica system, Feldspathoid-silica system, Diopside-Albite-Anorthite system, Diopside-Forsterite-Silica system. Orthothoclase – Albite system, its relevance to petrogenesis. Formation of perthite.

Unit III

Introduction to mantle processes, Continental and oceanic mantle lithosphere, MORB and depleted mantle, Evolution of depleted mantle.

OIB and Enriched mantle, Evolution of Enriched mantle- metasomatic processes, Island arc basalts, Concept of hot-spots, Mantle plumes- theory and structure, Re-Os isotope systematics, Trace elements characterization of mantle domains.

Unit IV

Petrogenetic provinces: Continental areas: Volcanic flood basalts, Tholeiites (Deccan

Traps, Columbia River basalts, Parna basalts); Layered gabbroic intrusions: The Bushveld Complex, Skaergaard intrusion, Stillwater Complex;

Plutonic: Carbonatites and alkaline rock complexes of India. Oceanic areas: Hawaiian, Kerguelen and Reunion Islands; Oceanic Rift valleys: MORB-Tholeiites-Ophiolites; Granite , its types and salient differences. Andesite, Kimberlites, Anorthosites, Charnockites,

Reference Books

1. Igneous Petrology: Mihir K. Bose, , World Press.

2. Igneous Petrology:Best, M. G., , CBS Publication.
3. Igneous Petrology: McBurney, A. R., , Jones and Bartlet Publication.
4. Igneous Petrology: Carmichael, Turner and Verhoogen.
5. Evolution of Igneous Rocks: Brown.
6. Igneous and Metamorphic Petrology (2nd edition): F. J. Turner, J. Verhoogen.
7. Igneous and Metamorphic Petrology: Dest.
8. Igneous and Metamorphic Petrology: Philipotts, A., , Prentice Hall.
9. Physical Chemistry of Magmas: Perchuk, L. L. and Kushiro, I. (eds), Springer – Verlag.
10. Laboratory Handbook of Petrographic Techniques, Hutchinson, C.S.,; John Wiley.

M. Sc. Part – I: Geology
Semester I

Title of Course: MET-104: Stratigraphy and Palaeontology
Course Code: MSU0325MEL921G1
Total Credits: 04

Unit I

Standard stratigraphic nomenclature code; Lithostratigraphy, Biostratigraphy, Chronostratigraphy, Concepts of Magnetostratigraphy, Chemostratigraphy, Event stratigraphy, Sequence stratigraphy, Cyclostratigraphy and Pedostratigraphy.

Correlation: Modern methods of stratigraphic correlation.

Stratigraphic procedures: Surface and subsurface.

Concept of lithofacies and biofacies. Stratigraphic boundary problems

Unit II

Precambrian stratigraphy of India-Distribution, lithology, tectonic history and correlation of Archaean and Proterozoic of Peninsula and Extra-peninsula,

Phanerozoic stratigraphy of India - Distribution, lithology, tectonic history and correlation of Phanerozoic sequences of India,

Unit III

Distribution of organisms in space and time, Evidence of life in Precambrian times. Techniques in the study of megafossils, microfossils, nanofossils, ichnofossils - Collection, reformation, and illustration, binomial nomenclature. Use of palaeontological data in- stratigraphy, palaeoecology, evolution, mineral (fuel) exploration, and palaeography.

Brief study of morphology, classification, evolutionary trends and distribution of Invertebrate phyla: Mollusca, Brachiopoda, Echinodermata, and Corals.

Plant fossils: Gondwana and Intertrappean flora.

Unit IV

A brief account of the vertebrate sequence through geological time. Brief study of evolution of Fishes, Elephant, Horse and Man. Introduction to Micropalaeontology, Types of microfossils, Palynalogy, Foraminifera and Ostracods, Molecular palaeontology.

Reference Books

1. Historical Geology and Stratigraphy of India: Ravindra Kumar.
2. A Manual of Geology of India and Burma, Vol. 1, 2, 3, and 4: E. H. Pascoe.
3. Geology of India: M. S. Krishnan.
4. Geology of India Vol. I and II : M.Ramkrishnan and R.Vaidyanathan Geological Society of India, Bangalore.
5. Purana Basins of India, Memoir: Geological Society of India, Bangalore.
6. Precambrian of South India: Geological Society of India, Bangalore.
7. Precambrian Stratigraphy of India: Naqvi and Rogers.
8. G. S. I. Memoirs and Record Volumes.
9. Invertebrate Palaeontology and Evolution, 2nd edition: Clarkson E. N. K.
10. Elements of Palaeontology: Babin C.
11. Principles of Invertebrate Palaeontology, 2nd edition: Shrock and Twenhofel.
12. Palaeontology of Vertebrates: Jean Chaline.
13. The Elements of Palaeontology: R. N. Black.
14. Micropalaeontology: Bignot
15. Invertebrate Palaeontology: Woods H.
16. Fossils in Earth Science: Anis Kumar Ray, Prentice Hall India
17. Fundamentals of Micropalaeontology- M.A.Koregave

M. Sc. Part – I: Geology
Semester I

Title of Course: MET-105: Remote Sensing and Geomorphology
Course Code: MSU0325MEL921G2
Total Credits: 04

Unit I

Concept of Remote Sensing, Electromagnetic Energy and spectrum, Interaction of electromagnetic energy with water, soil and vegetation. Types of sensors, Aerial photographs

and their types, Aerial cameras and films, Scale of aerial photographs, Aerial mosaics and Photo-recognition elements.

Global and Indian space missions, Different satellite programs of India.

Unit II

Satellite Remote Sensing, Visual interpretation and Digital Image Processing Techniques. Principles of Terrain Analysis. Interpretation of topographic and tectonic features-Lineaments, Joints, Folds and Unconformity, Rock type identification.

Uses of remote sensing in Resource Exploration, Applications in Environmental Studies and Natural Hazards mitigation, Groundwater Potential Evaluation.

Unit III

Influence of climate on weathering, Soil and mass wasting, Development and types of soils.

Geomorphic processes with associated dynamics and resulting landforms- slope, channel, coastline, glacial, aeolian and karst landscapes.

Unit IV

Morphometric Analysis, slope analysis, drainage analysis; Geomorphological mapping based on genesis of landforms.

Terrain evaluation for strategic purpose. Principles and applications of Geographic Information System.

Reference Books

1. Principles and Applications of Photogeology: S. N. Pandey.
2. Photogeology and Regional Mapping: J. A. E. Allum.
3. Remote Sensing and Image Interpretation: Lillesand Kiefer.
4. Photogeology: Miller and Miller.
5. Fundamentals of Geomorphology: R. J. Rice
6. Geomorphological Techniques, 2nd edition: Andrew Gaudia
7. Principles of Geomorphology: W. D. Thornbury.
8. Geomorphology and Remote Sensing in Environmental Management: Surendra Singh.
9. Geomorphology: Majid Hussain.
10. Indian Geomorphology: H. S. Sharma.
11. Experimental Fluvial Geomorphology: Stanley A. Schumm et al.
12. Geomorphology: Richard J. Chorley.
13. Remote Sensing, 2nd Revised Ed. : A.N.Patel, Surendev Singh
14. Remote Sensing for Environmental Science: Jenson.

M. Sc. Part – I: Geology
Semester I

Title of Course: RM108: Research Methodology
Course Code: MSU0325RML921G
Total Credits: 04

Unit 1:

Preparation for Field work, Field procedures in Geological mapping in Igneous, Sedimentary and metamorphic terrains. Methods used in sampling of rocks, minerals, fossils and groundwater. Procedures used in water and rock analysis in laboratory. (No. Of lectures -15)

Unit 2:

Introduction to advanced laboratory techniques including Differential Thermal Analysis, X- ray diffraction method, Scanning Electron Microscopy, Emission and absorption Spectroscopy.

Unit 3:

Remote Sensing application in geology, Basic statistical methods used in Geology, statistical software. Introduction to computer Applications. Fundamentals of Computer Applications, software, Browsers, word processors, spread sheets. (No. Of lectures -15).

Unit 4:

Database Management Systems, Presentation graphics, Internet & Intranet communication. Writing of reports and research papers in Geology. Preparation of Minor and major research projects. Information of various funding agencies. (No. Of lectures -15).

Reference Books

1. Manual of Field Geology By Crompton.
2. Statistics and data analysis in geology by Davis.
3. An introduction to statistical model in geology by W.C.Krumbein and F.A. Graybill.
4. Statistical analysis in geological sciences by Miller and Khan.
5. Field Geology: Lahee.

Practical Lab-I

MMPR-103 : Based on MMT-101 and Based on MMT-102
Course Code: MSU0325MMP921G1
Total Credits: 04

Mineralogy

Megascopic and microscopic study of major rock forming minerals with emphasis on distinguishing features.

Calculation of mineral formula of the following- olivine, pyroxene, amphibole, and garnet.

Optics

Study of interference figures, optic axis, optic sign, and flash figure of uniaxial and biaxial minerals.

Crystallography

Measurement of interfacial angles and study of classification, Forms present, symmetry elements of Normal class of Isometric, Tetragonal, Hexagonal, Orthorhombic, Tetragonal and Monoclinic systems.

Study of twin crystals.

Igneous Petrology

Megascopic and microscopic study of representative igneous rocks.

Calculation of CIPW norms.

Niggli calculations.

Preparation of variation diagrams.

Quantitative mineralogical studies in thin section and rock classification.

Practical Lab-II

MEPR-106/107 : Based on Stratigraphy and Palaeontology (MET-104)/ Remote Sensing and Geomorphology (MET-105)
Course Code: MSU0325MMP921G2
Total Credits: 02

Stratigraphy

Drawing of geological maps of different Supergroups and Groups of India.

Preparation of palaeogeographic maps of India for different geological periods.

Palaeontology

Identification and study of invertebrate fossils, illustrating functional morphology and classification.

Identification of plant fossils- Gondwana and intertrappean flora.

Sample preparation for micropalaeontological studies, Identification of microfossils- Foraminifera and Ostracoda.

Remote Sensing

Determination of geometrical properties of aerial photographs, Study of landforms, Interpretation of lithology and structure in aerial photographs and satellite imageries, Study and analysis of lineaments and drainage in aerial photographs.

Geomorphology

Basin demarcation, ordering of streams by Strahler's and Horton's methods, Calculation of drainage density and bifurcation ratio; Slope of the basin- Schumm's method.

Slope analysis, Texture ratio, Planar surfaces, Determination of altitude frequency, Hypsometric curves and hypsometric integer, Source heads and confluence points. Study of different Geomorphological features.

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M. Sc. Part – I: Geology
Semester II

Title of Course: MMT-201: Metamorphic Petrology
Course Code: MSU0325MML921H1
Total Credits: 04

Unit I

Types of metamorphism, Ocean floor metamorphism. Metamorphic minerals. Metamorphic reactions.

Field observations: Recognition of Textures and structures related to metamorphism- Deformation textures and structures, Recrystallisation textures and structures, Petrographic classification of metamorphic rocks,

Unit II

Regional and thermal metamorphism of pelitic rocks, Regional and thermal metamorphism of Basic igneous rocks, Regional and thermal metamorphism of impure, siliceous carbonate rocks.

Concepts of Metamorphic Grades and Facies. Very low grade, low grade, medium grade, high grade metamorphism. Elemental exchange and P-T conditions of isograds. Different metamorphic facies.

Unit III

Mineralogical phase rule of closed and open system, Phase diagram and graphic representation of mineral assemblages. Schreinmarker's rule and chemographic diagrams such as ACF, AKF and AFM diagrams,

Granulites, Charnockites and Eclogites. Palingenesis, Anatexis and migmatites, Granitization, Prograde and Retrograde metamorphism, polymetamorphism.

Unit IV

Metasomatism, Relationship of metamorphic rocks and associated mineral deposit, Geothermometers and geobarometers.

Metamorphism in space and time: Plate Tectonics and metamorphic processes, Paired metamorphic belts, Archaean and Proterozoic terrains.

Reference Books

1. Metamorphic Petrology: F. J. Turner,; McGraw Hill, Newyork

2. Metamorphic Petrology: C. B. Rao.
3. Metamorphic Petrology, 4th edition: Winkler
4. Metamorphic Petrology: Harker.
5. An Introduction to Metamorphic Petrology: Yardley, B. W., , Longman,Newyork
6. Petrogenesis of Metamorphic Rocks: Bucher, K. and Frey, M., Springer – Verlag.
7. Igneous and Metamorphic Petrology: Philipotts, A., , Prentice Hall.
8. Metamorphic Crystallisation: Kretz, R., John Wiley.
9. Metamorphism and Metamorphic Belts: Miyashiro, A.,.
10. Characterisation of Metamorphism through Mineral Equillibria: J. M. Ferry ed., Reviews in Mineralogy, Vol. 10, Mineralogical Society of America.
11. Experimental Petrology: Alok Gupta.

M. Sc. Part – I: Geology
Semester II

Title of Course: MMT-202: Sedimentary Petrology
Course Code: MSU0325MML921H2
Total Credits: 04

Unit I

Sediment transport mechanism; Deposition by fluids- simple fluid flow concepts- Reynold number and Froude number.

Lithification and Diagenesis: Definition, principles, major stages in lithification and diagenesis of clastic and chemical rocks with reference to sandstones and limestones.

Unit II

Sedimentary Textures: Textural elements of clastic and non-clastic rocks, Concept of size and shape, Shape aspects- sphericity, roundness, form; Surface textures, *fractal*, fabric- their measurement, statistical treatment and interpretation, Methods of mineral separation and quantitative and qualitative analysis.

Genesis and Significance of Sedimentary structures - Syndepositional and Post- depositional, Principles of statistical treatment of palaeocurrent analysis.

Application of textures and structures in sediment dispersal and basin analysis studies. Purpose and scope of basin analysis.

Unit III

Provenance: Introduction, definition and concepts, Minerals and source rocks; Mineral stability in the soil profile and during transit, intrastratal mineral stability, Heavy mineral zones, Theoretical and other considerations related to mineral stability, Reading provenance history.

Sedimentary Environments: Classification of environments- continental, marine, transitional; their physical and chemical parameters, lithology and lithological associations;

Importance of Structures in interpretation of alluvial, fluvial, deltaic, laccustrine, coastal, shallow marine, deep marine, glacial and aeolian environments.
Concept of sedimentary facies - Extrabasinal and Intrabasinal.

Unit IV

Sandstones: Classification, light and heavy minerals, tectonic setting;

Limestones: Classification, mineralogy, environment of deposition, Dolomitisation and dedolomitisation;

Evaporites, phosphorites, Chert and Fe-Mn rich rocks- genesis and environment of deposition. Volcanogenic sedimentary rocks.

Sedimentation and Tectonics: Tectonic controls of sedimentation, diastrophic cycle, Sediment cycle.

Reference Books

1. Sedimentary Petrology 3rd edition : Pettijohn, F. J., , CBS Publi.
2. Origin of Sedimentary Rocks, 2nd edition : Blatt, Middleton and Murray.
3. Depositional Sedimentary Environments: Reineck and Singh.
4. An Introduction to Sedimentary Rocks: R. C. Selley.
5. Sedimentary Rocks: R. K. Sukhatankar.
6. Palaeocurrent and Basin Analysis: Potter, Pettijohn and Siever.

M. Sc. Part – I: Geology
Semester II

Title of Course: MET-204: Geophysics and Exploration Methods
Course Code: MSU0325MEL921H1
Total Credits: 04

Unit I

The Exploration by Geological criteria of mineral deposits, Geochemical tools and methods involving various geochemical mapping techniques. Integrated approach of geophysical methods in mineral exploration, groundwater and petroleum exploration.
Radioactivity of rocks and minerals, Alpha, Beta and Gamma radiation sources, Occurrence of radioactive minerals, Half-life, fussion, fission; Dating radioactive traces, field equipment and procedures.

Unit II

Variation of gravity over the surface of the earth; principles of gravimeters; gravity field surveys; various types of corrections applied to gravity data; preparation of gravity anomaly maps and their interpretation in terms of shape, size and depth.

Geomagnetic field of the earth; magnetic properties of rocks; working principles of magnetometers; field surveys and data reductions; preparation of magnetic anomaly maps and their quantitative interpretation; magnetic anomalies due to single pole, dipole; introduction to aeromagnetic surveys, three dimensional current flow, potential due to a point current source.

Unit III

Resistivity methods; basic principles; various types of electrode configurations; field procedure profiling and sounding and interpretation, application of electrical method in groundwater prospecting and civil engineering problems. Interpretation techniques for resistivity sounding, self-potential methods, Induced polarization methods.

Electromagnetic methods- Basic principle, instruments used and interpretation of electromagnetic surveys. Introduction to the methods using artificial and natural fields-Telluric, Magneto-telluric and airborne electromagnetic methods.

Unit IV

Seismic methods; fundamental principles of wave propagation; refraction and refraction surveys for single interface, horizontal and dipping cases; concept of seismic channels and multy- channel recoding of seismic data; End- on and split spread shooting techniques; CDP method of data acquisition; sorting; gather; stacking and record section; seismic velocity and interpretation of seismic data.

Introduction to logging, Aims and objectives, Classification of logging methods and techniques, Basic principles, Instrumentation, field procedures. Interpretation of well logs and their applications.

Books Recommended

1. Sharma, P.V. Geophysical Methods in Geology
2. Dobrin, M. B. Introduction to Geophysical Prospecting, McGrow Hill.
3. Paransis, D.S. Principles of Applied Geophysics
4. Stanislave,M. Introduction to Applied Geophysics
5. Rao, M.B.R. Outlines of Geophysical Prospecting Manual for Geologists
6. Ramam, P.K. Principles and Practices of Mineral Exploration, Geological Society of India,Banglore.
7. Stenislave, M. Introduction to applied Geophysics, Reidel Publ.
8. Lowrie, W. Fundamental of Geophysics, Cambridge University Press.

9. Mussette, A.E. and Khan, M.A. Looking into the earth: An introduction to geological geophysics, Cambridge University Press.

M. Sc. Part – I: Geology
Semester II

Title of Course: MET-205: Mining Geology
Course Code: MSU0325MEL921H2
Total Credits: 04

Unit I

Application of geology in mining, guides in the location of ore deposit- physiographic, lithologic, stratigraphic, mineralogic and structural guides, Appraisal of exploration data forexploratory mining. Terms used in exploratory mining, introductory aspect of mine planning. Mine development.

Types of mining- Alluvial Mining, Quarrying and Open cast Mining, Underground Mining.

Open Cast Mining Methods- Excavation, Benching, Levelling. Methods of breaking rocks- Blasting practices- Drilling blast holes, Explosives used in mining, Transportation of ore.

Underground Mining Methods for metallic, non-metallic minerals- Modes of entry to mineral deposits Adit, Tunnel, Incline or vertical Shaft. Underground exploration methods in mining, geotechnical investigations for mine planning, mining machinery, transportation: haulage and hoisting. Mine organization and operations- Shaft Sinking, drifting, cross cutting, winzing, stopping, room & pillaring, top – slicing, sub – level caving and block caving; Mine drainage; ventilation; illumination.

Unit II

Mine hazards and Safety works- Mine inundation, Fire and Rock burst, Subsidence.

Support of mine excavation; timber treatment, safety measures in underground and open cast mines, rescue work.

Factors in evaluating mineral deposits. Objectives of valuation, Mine examination. Theory and methods of Sampling, Sampling calculations, recoverable values.

Unit III

Cost of mining, Life of mine, Future costs and profits, Present value of mine and its determination by compound interest and Hoskold formula method. Amortization; Scope of Mineral Dressing; Historical Outline; Properties of Ores and minerals applied to mineral beneficiation – Hardness, specific gravity, Colour, Diaphaneity. Ore microscopy. Operating steps involved- Size reduction– Crushing- Crushers

– Jaw Crushers, Blake type, and Dodge type. Gyratory crushers, Cone crushers, Roll crushers – Angle of NIP, Fine crushers, Special crushers. Ri Hinger's Law, Kick's Law, Bond's Theory. Screening – Hand screening, Automatic screening, Sieve shakers. Laboratory sizing – Graphical representation of size analysis.

Unit IV

Principles of Concentration Processes, Flowing film Concentration Process, Gravity Concentration Process. Jigging, Tabling, Comparison between Jigging & Tabling, Jigging cycles. Magnetic separation- Principles and applications, Classification of magnetic separaters- Ball Norton Drum Separator, Ding's Wet Magnetic Separator. Principle of Electromagnetic separators.

Pneumatic concentration – Amalgamation, Flotation principles, Types of flotation, Reagents used in flotation, Collectors, Frothers, Depressants, Modifiers, Coal Dressing – Heavy Media separation. Agglomeration Techniques – Pellitisation

Process, Nodulizing Process, Briquetting process, Sintering process.

Books Recommended

1. Elements of Mining – Young G. J.
2. Elements of Mining – Lewis R. A. & Clark G. A.
3. Mining Geology – Arogyaswami – Courses in mining geology: Oxford and IBH
4. Pub. Co., New Delhi.
5. Mining Geology – McKinstry H. E. Prentice Hall Inc.
6. Mining of Mineral deposals – Sheryanthov L.
7. Principles of Mineral Dressing – Garudin A. M. (McGraw Hill)
8. Elements of Ore Dressing – Taggart A. F. (John Wiley)
9. Principles of Mineral Beneficiation – Wells & Wells
10. Mineral Processing – Pray (Elsevier)
11. Ore Processing – Jain S. K. (Elsevier)
12. Peele, R. and Church, J.A. Handbook of mining (Vol.I and II) Wiley Eastern Ltd, New Delhi

Practical Lab-I

MMPR-203 : Based on MMT-201 and Based on MMT-202
Course Code: MSU0325MMP921H1
Total Credits: 04

Metamorphic Petrology

Megascopic and microscopic study of textures, structures and minerals in metamorphic rocks and their classification.

Study of representative metamorphic rocks.

Calculation and plotting of ACF, AFM and AKF diagrams and their interpretation.

Sedimentary Petrology

Megascopic and microscopic characters of clastic and non-clastic rocks,

Study of sedimentary textures, structures and their significance.

Identification of types of sandstones and limestones in micro-sections.

Study of heavy minerals.

Determination of sphericity and roundness of grains, Sieve analysis, Graphical presentation of data and determination of statistical parameters.

Practical Lab-II

MEPR-206/207 : Based on Geophysics and Exploration Methods (MET-204)/ Mining Geology (MET-205)
Course Code: MSU0325MMP921H2
Total Credits: 02

Application of geophysical data for geological purpose.
Interpretation of surface geophysical data in mineral exploration- gravity data, magnetic data, electrical data. Utility of seismic reflection data in recognition of subsurface structures; interpretation of seismic data.
Interpration of logging data.
Determination and evaluation of ore in mines; classification of ore reserves and mineral resources (UNFC classification system), use of computers in ore reserve estimation, Sampling calculations; recoverable values; cost of mining; Future costs and profits, Life of a mine. Determination of present value of mine. Drawing cross section of mine with the help of available data.

Problems – Roll crusher angle of NIP, Relation between size of feed and size of produce; Size analysis of ground material their graphical representation; Study of settling rate of solids with respect to Stoke's Law and Rittinger's Law using clay samples; Calculation of ratio of concentration and recovery percentages.

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9. SCHEME OF TEACHING AND EXAMINATION:

(Applicable to University Department and University affiliated colleges' centers).

❖ Each unit in theory course shall comprise 15 lectures, each of 60 minutes' duration and there shall be four lectures per theory course per week.

❖ Entire course of M. Sc. Geology will be of 2200 marks. Every Semester will be of 550 marks.

❖ Examination of each theory course shall be of 100 marks (80 University Examination + 20 Internal Assessments). University examination of 80 marks (3 hours' duration) will be conducted at the end of each Semester. Internal assessment of 20 marks will be conducted before the semester examination during each semester.

❖ Examination of practical course shall be of 150 marks.

❖ Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

10.NATURE OF THEORY & PRACTICAL QUESTION PAPER AND SCHEME OF MARKING:

Theory and Practical examination shall be conducted at the end of each Semester.
Question Paper will be set in the view of the / in accordance with the entire syllabus of the semester and preferably covering each unit of syllabus.

Theory Examination

- Theory papers will be of 3 hours duration and 80 marks each.
- There will be internal examination of 20 marks for each paper.
- Each theory paper will consist of 7 questions of 16 marks each.
- Question No. 1 is compulsory.
- Has to be answered **any Four** questions from **2 to 7.** All questions amounting to maximum 80 marks as detailed below:

Q. No. 1: Objective Question with 4 multiple choice of 1 mark each, total 16 Questions (Fill in the Blanks type)

Q.No. 2, 3, 4, 5 & 6 : Each question is either one long answer type descriptive question of 16 marks or 2 brief answer type questions of 8 marks each.

Q. No. 7 : Six short notes of 4 marks each, out of which four to be solved for 16 marks

Practical Examination

Practical Lab-I- MP101 -based on MT101 and MT102,
100 marks

Que. 1 Experiment/Experiments Based on **MT101**	20
Que. 2 Experiment/Experiments Based on **MT101**	20
Que. 3 Experiment/Experiments Based on **MT102**	20
Que. 4 Experiment/Experiments Based on **MT102**	20
Que. 5 *Viva voce*	10
Que. 6 Journal	10

For passing in MP101, student must score minimum 40 marks out of 100 in practicalexamination.

Practical Lab-II- EP101/102 -based on ET-101/102
50 marks

Que. 1 Experiment/Experiments Based on ET101/102	20
Que. 2 Experiment/Experiments Based on ET101/102	20
Que. 3 *Viva voce*	05
Que. 4 Journal	05

For passing in EP101/102, student must score minimum 20 marks out of 50 in practical examination.

Practical Lab-III- MP201- based on MT201 and MT202,
100 marks

Que. 1 Experiment/Experiments Based on **MT201**	20
Que. 2 Experiment/Experiments Based on **MT201**	20
Que. 3 Experiment/Experiments Based on **MT202**	20
Que. 4 Experiment/Experiments Based on **MT202**	20
Que. 5 *Viva voce*	10
Que. 6 Journal	10

For passing in MP201, student must score minimum 40 marks out of 100 in practicalexamination.

Practical Lab-IV- EP201/202- based on ET201/202
50 marks

Que. 1 Experiment/Experiments Based on ET201/202	20
Que. 2 Experiment/Experiments Based on ET201/202	20
Que. 3 *Viva voce*	05
Que. 4 Journal	05

For passing in EP201/202, student must score minimum 20 marks out of 50 in practicalexamination.

SCHEME OF EXAMINATION FOR INTERNAL ASSESSMENT:

Course Type	Total Internal Assessment Marks	Class Test	Seminar Presentation	Assignment	Project Reports	Study Tour Report	Supervisor's Report
Theory	20	10	--	10	--	--	--
Practical – 4 Credits	Nil	--	--	--	--	Required	--
Practical – 2 Credits	Nil	--	--	--	--	Required	--
Field Project / On Job Training – 4 Credits	40	--	Required	--	Required	--	40
Research Project – 4 Credits	20	--	Required	--	Required	--	20

SCHEME OF EXAMINATION FOR FIELD PROJECT / JOB TRAINING (60 MARKS):

Que. 1. Seminar Presentation 20 Marks
Que. 2. Evaluation of Project Report/Job Report 30 Marks
Que. 3. Viva Voce 10 Marks

SCHEME OF EXAMINATION FOR RESEARCH PROJECT (80 MARKS)

Que. 1. Seminar Presentation 20 Marks
Que. 2. Evaluation of Project Report/Job Report 40 Marks
Que. 3. Viva Voce 20 Marks

12. Equivalence of courses

M. Sc. Part I (Semester I and II)

Old Course				Equivalent Course		
Sem No.	**Course Code**	**Title of Old Course**	**Credit**	**Course Code**	**Title of New Course**	**Credit**
I	CC-101	Mineralogy, Optics and Crystallography	04	**MSU0325MML921G1**	Mineralogy, Optics and Crystallography	04
I	CC-102	Igneous Petrology	04	**MSU0325MML921G2**	Igneous Petrology	04
I	CC-103	Metamorphic Petrology	04	**MSU0325RML921G**	Research Methodology	04
I	CC-104	Sedimentary Petrology	04	**MSU0325MEL921G1/ MSU0325MEL921G2**	Stratigraphy and Palaeontology/Remote Sensing and Geomorphology	04
I	CCPR-105	Core Course Practical	08	**MSU0325MMP921G1**	Practical Lab-I	04
I	AEC-106	Non-CGPA(Mandatory)	--	**MSU0325MMP921G1**	Practical Lab-II	02
II	CC-201	Structural Geology and Geotectonics	04	**MSU0325MML921H1**	Metamorphic Petrology	04
II	CC-202	Stratigraphy and Palaeontology	04	**MSU0325MML921H2**	Sedimentary Petrology	04
II	CC-203	Economic Geology	04	**MSU0325FPP921H/ MSU0325OJP921H**	Field Project/OJT	04
II	CC-204	Remote Sensing and Geomorphology	04	**MSU0325MEL921H1/ MSU0325MEL921H2**	Geophysics and Exploration Methods/Mining Geology	04
II	CCPR-205	Core Course Practical	08	**MSU0325MMP921H1**	Practical Lab-III	04
II	SEC-206	Non-CGPA(Mandatory)	--	**MSU0325MMP921H2**	Practical Lab-IV	02