SYLLABI AND SCHEME OF EXAMINATIONS FOR SKILL ENHANCEMENT COURSES FOR UNDER GRADUATE PROGRAMS (SINGLE MAJOR / PHYSICAL SCIENCES PROGRAMS) OFFERED BY THE DEPARTMENT OF GEOLOGY

(Based on Curriculum and Credit Framework guidelines for UG Programs under NEP 2020)

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

SYLLABI AND SCHEME OF EXAMINATIONS FOR SKILL ENHANCEMENT COURSES FOR UNDER GRADUATE SINGLE MAJOR/MULTIDISCIPLINARY PROGRAMS/ SINGLE MAJOR PROGRAM AFTER 2nd SEMESTER OF MULTIDISCIPLINARY PROGRAM

Skill Enhancement Course (SEC)	Nomenclature of Course	Course Code	Credits Distribution			Total Credits	Workload			Total Workload	Marks			Total Marks
			L	T	P		L	T	P		Theory		Prtactical	
											Intern-al	Exte-rnal	Only Internal	
SEMESTER 1														
SEC 1 @ 3 credits	Geophysical Prospecting	**24GOL401SE01**	3	0	0	3	3	0	0	3	25	50		75
SEMESTER II														
SEC 2 @ 3 credits	Basic Field Training and Report Writing	**24GOL402SE01**	3	0	0	3	3	0	0	3	25	50		75
SEMESTER III														
SEC 3 @ 3 credits	Geochemical Analysis Techniques	**25GOL403SE01**	3	0	0	3	3	0	0	3	25	50		75
SEMESTER VI														
SEC 4 @ 2 credits (offered only in case of Single Major Programme)	Thin Section Making and Geological Mapping	**26GOL406SE01**	0	0	2	2	0	0	4	4			50	50
SEMESTER VII														
SEC 5 @ 4 credits	Surveying Techniques and GIS	**27GOL407SE01**	0	0	3	3	0	0	6	6			75	75
SEMESTER VIII														
SEC 6 @ 4 credits	Gemmology	**27GOL408SE01**	0	0	3	3	0	0	6	6			75	75

L: Lecture; T: Tutorial; P: Practical

Semester: I

Name of Program		**Program Code**	
Name of the Course	Geophysical Prospecting	**Course Code**	24GOL401SE01
Hours per Week	03 Hours	**Credits**	03 (L:3,P:0)
Maximum Marks	{External (term-end exam) – 50} (Internal – 25)	**Time of Examinations**	3 hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabi. The candidate must attempt five questions in all selecting at least one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02) and out of which the student will be required to attempt any 05 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each from all the four units.

Course Learning Outcomes (CLO):

CLO 1: Students will Demonstrate Knowledge of Various Geophysical Methods Used in Prospecting, Including Seismic, Gravity, Magnetic and Electrical.

CLO 2: Students will Gain Practical Experience in Using Geophysical Instruments for Data Acquisition, Including Field Procedures, Equipment Operation, and Quality Control.

Unit 1: Geology and Geophysics: Interrelationship between Geology and Geophysics, Role of Geological and Geophysical Data in Explaining Geodynamical Features of the Earth.

Unit 2: Gravity and Magnetic Methods: Gravimeter and Magnetometer, Principles of Gravity and Magnetic Anomalies, Applications in Geological Mapping and Mineral Exploration.

Unit 3: Electrical Methods (DC Resistivity and Induced Polarization): Principles of Electrical Resistivity and IP Methods, Applications in Groundwater Studies and Environmental Investigations.

Unit 4: Seismic Methods (Reflection and Refraction): Principles of Seismic Wave Propagation, Interpretation of Seismic Data for Subsurface Imaging.

References:

1. Telford, W. M., Geldart, L. P., Sheriff, R. E., & Keys, D. A. (1990). Applied Geophysics (2nd ed.). Cambridge University Press.
2. Kearey, P., Brooks, M., & Hill, I. (2002). An Introduction to Geophysical Exploration (3rd ed.). Blackwell Science.
3. Lowrie, W. (2007). Fundamentals of Geophysics. Cambridge University Press.

Semester: II

Name of Program		**Program Code**	
Name of the Course	Basic Field Training and Report Writing	**Course Code**	24GOL402SE01
Hours per Week	03 Hours	**Credits**	03 (L:3,P:0)
Maximum Marks	75{External (term-end exam) – 50} (Internal – 25)	**Time of Examinations**	3 hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabi. The candidate must attempt five questions in all selecting at least one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02) and out of which the student will be required to attempt any 05 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each from all the four units.

Course Learning Outcomes (CLO):

CLO 1: The student Gets Familiar with the Fundamental Idea of Reading Topographical and Structural Features from the Map and Basic Methods of Geomorphological Mapping.

Unit 1: Orientation of Topographic Maps in Field, Marking Location in Toposheets, Concept of Bearing; Topographic Distance, Height and Pace Approximation.

Unit 2: Identification of Rock Types in Field; Structures and Texture of Rocks, Use of Various Field Tools.

Unit 3: Basic Field Measurement Techniques, Preparation of Vertical Profile.

Unit 4: Field Work Practice and Report Writing.

References:

1. Lahee, (1961) Field Geology Frederic Henry, Mc-Graw Hill Book Comp., London, N. York.
2. Kennedy, M., Kopp, S. (2001). Understanding Map Projections, Esri Press.
3. Kimerling, A .J., Buckley, A.R., Muehrcke, P.C.,Muehrcke, J. O. (2011). Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.
4. Monkhouse, F. J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed. Alphaneumera-Kolkata.
5. Pearson II, F. 1990. Map Projections: Theory and Applications 2nd ed, CRC Press.
6. Robinson, A. H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.
7. Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Name of Program		**Program Code**	
Name of the Course	Geochemical Analysis Techniques	**Course Code**	25GOL403SE01
Hours per Week	03 Hours	**Credits**	03 (L:3,P:0)
Maximum Marks	{External (term-end exam) – 50} (Internal – 25)	**Time of Examinations**	3 hours

Note: The examiner will set nine questions in all into five sections A, B, C, D, and E of the question paper from all the four units - I, II, III and IV of the syllabi. The candidate must attempt five questions in all selecting at least one question from each section. The question given in section A is compulsory comprises 08 short answer type questions two from each unit (each of marks 02) and out of which the student will be required to attempt any 05 questions. In the remaining sections B, C, D and E there will be two questions of 10 marks each from all the four units.

Course Learning Outcomes(CLO):

CLO1: Understand and apply appropriate sampling techniques and sample preparation methods for various geochemical materials, ensuring accuracy and representativeness in analysis.

CLO2: Demonstrate knowledge of classical wet chemical techniques such as acid digestion and flux fusion, and apply them effectively for sample dissolution and elemental analysis.

CLO3: Explain the principles, instrumentation, and analytical applications of ICP-AES and ICP-MS, and evaluate their use in major, trace, and ultra-trace element detection.

CLO4: Interpret data obtained from XRF, XRD, and EPMA techniques, and assess their applications and limitations in solid-state geochemical analysis.

CLO5: Develop proficiency in quality control and assurance procedures to ensure the reliability and reproducibility of geochemical data.

Unit 1: Sampling Techniques and Preparation

Introduction to geochemical sampling, types of samples, field methods for collection, preservation, transport, and contamination control, followed by drying, crushing, grinding, sub-sampling, and storage techniques.

Unit 2:Wet Chemical Techniques

Acid digestion methods including aqua regia, HF, and microwave digestion, flux fusion techniques, handling of interferences and pre-concentration steps.

Unit 3:ICP-AES and ICP-MS

Principles, instrumentation, and applications of ICP-AES and ICP-MS, including sample introduction, plasma generation, detection systems, spectral and isobaric interferences, calibration, and comparison of both techniques.

Unit 4:XRF, XRD, and EPMA

Overview of XRF for elemental analysis, XRD for mineral identification, and EPMA for micro-scale elemental analysis, with emphasis on principles, instrumentation, sample prep, data interpretation, and limitations.

References:

1. Rollinson, H. R. (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman Scientific & Technical.
2. Potts, P. J. (1987). A Handbook of Silicate Rock Analysis. Blackie & Son Ltd.
3. Jenner, G. A., Longerich, H. P., Jackson, S. E., & Fryer, B. J. (1993). ICP-MS – A powerful tool for high-precision trace-element analysis in Earth sciences: Evidence from analysis of selected U.S.G.S. reference samples. Chemical Geology, 83(1-2), 133–148.
4. Jansen, J. B. H., & van der Gaast, S. J. (2002). X-ray Powder Diffraction and X-ray Fluorescence Analysis of Geological Materials. University of Utrecht.
5. Reed, S. J. B. (2005). Electron Microprobe Analysis and Scanning Electron Microscopy in Geology. Cambridge University Press.
6. Rollinson, H. R. (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman Scientific & Technical.
7. Potts, P. J. (1987). A Handbook of Silicate Rock Analysis. Blackie & Son Ltd.
8. Jenner, G. A., Longerich, H. P., Jackson, S. E., & Fryer, B. J. (1993). ICP-MS – A powerful tool for high-precision trace-element analysis in Earth sciences: Evidence from analysis of selected U.S.G.S. reference samples. Chemical Geology, 83(1–2), 133–148.
9. Jansen, J. B. H., & van der Gaast, S. J. (2002). X-ray Powder Diffraction and X-ray Fluorescence Analysis of Geological Materials. University of Utrecht.
10. Reed, S. J. B. (2005). Electron Microprobe Analysis and Scanning Electron Microscopy in Geology (2nd ed.). Cambridge University Press.

Name of Program		**Program Code**	
Name of the Course	Thin Section Making and Geological Mapping	**Course Code**	26GOL406SE01
Hours per Week	04 Hours	**Credits**	02 (L:0, P:2)
Maximum Marks	50 (Internal)	**Time of Examinations**	03 Hours

Note: There will be five questions in all, and the students must attempt any three questions. The question paper will be set by the internal examiner. The distribution of Marks will be as follows:

Marks for Question Paper:	33
Marks for Practical Record Book:	07
Marks for Viva-Voce:	05
Attendance :	05
Total:	50

Course Learning Outcomes (CLOs)

CLO 1: Demonstrate the preparation of standard geological thin sections from rock specimens.
CLO 2: Identify common rock-forming minerals in thin sections using a polarizing microscope.
CLO 3: Interpret mineralogical composition, textures and structures of rocks from thin sections.
CLO 4: Apply geological mapping techniques for recording lithological boundaries and geological structures in the field.
CLO 5: Prepare geological maps, cross-sections and field reports using standard geological mapping methods.

List of Practicals:

1. Introduction to thin section preparation and laboratory safety.
2. Selection, cutting and trimming of rock specimens.
3. Mounting, grinding and polishing of rock slices for thin section preparation.
4. Final finishing and quality assessment of thin sections.
5. Study of prepared thin sections under a polarizing microscope.
6. Identification of common rock-forming minerals in thin sections.
7. Recognition of mineral textures and rock fabrics in igneous, sedimentary and metamorphic rocks.
8. Introduction to geological mapping and essential field equipment.
9. Measurement of strike and dip using Brunton compass.
10. Recording field observations and preparation of field notes.
11. Preparation and interpretation of geological maps.
12. Construction of geological cross-sections from geological maps.

References:

1. Hutchison, C. S. (1974). Laboratory Handbook of Petrographic Techniques. John Wiley & Sons.
2. Shelley, D. (1993). Optical Mineralogy (2nd ed.). Chapman & Hall.
3. Nesse, W. D. (2013). Introduction to Optical Mineralogy (4th ed.). Oxford University Press.
4. Mackenzie, W. S., Guilford, C., & Yardley, B. W. D. (1995). Atlas of Rock-Forming Minerals in Thin Section. Longman.
5. Mackenzie, W. S., & Adams, A. E. (1994). A Colour Atlas of Rocks and Minerals in Thin Section. Manson Publishing.
6. Perkins, D. (2011). Mineralogy (3rd ed.). Pearson Education.
7. Deer, W. A., Howie, R. A., & Zussman, J. (2013). An Introduction to the Rock-Forming Minerals (3rd ed.). Mineralogical Society.
8. Kerr, P. F. (1977). Optical Mineralogy (4th ed.). McGraw-Hill.
9. Bloss, F. D. (1999). Optical Crystallography. Mineralogical Society of America.
10. Yardley, B. W. D., MacKenzie, W. S., & Guilford, C. (1990). Atlas of Metamorphic Rocks and Their Textures. Longman.
11. Compton, R. R. (1985). Geology in the Field. John Wiley & Sons.
12. Lahee, F. H. (1961). Field Geology. McGraw-Hill.
13. Lisle, R. J., Brabham, P., & Barnes, J. W. (2011). Basic Geological Mapping (5th ed.). Wiley-Blackwell.
14. Barnes, J. W., & Lisle, R. J. (2004). Techniques in Geological Mapping. Geological Society of London.
15. Maley, T. S. (1994). Field Geology Illustrated. Mineral Land Publications.
16. Bennison, G. M. (2002). An Introduction to Geological Structures and Maps (7th ed.). Hodder Arnold.
17. Singh, P. (2013). Engineering and General Geology. S. K. Kataria & Sons.
18. Geological Survey of India. Manual of Geological Field Techniques. GSI Publications.
19. Geological Survey of India. Geological Maps of India and Explanatory Memoirs. GSI Publications.