M.Sc. – II
GEOLOGY Syllabus
Credit Based and Grading System
To be implemented for the Academic year 2020-2021

M.Sc. – II SEMESTER III
GEOLOGY Syllabus

Theory

Course	UNIT	HYDROGEOLOGY	Credits	L / Week
PSGE31	I	Introduction to Hydrogeology	4	8
	II	Properties of Rocks and Groundwater		
	III	Groundwater Exploration		
	IV	Chemical properties of groundwater		

Course	UNIT	GEOPHYSICAL AND GEOCHEMICAL METHODS OF PROSPECTING	Credits	L / Week
PSGE32	I	Introduction and application	4	8
	II	Gravity exploration		
	III	Seismic Prospecting Electrical prospecting methods		
	IV	Magnetic Exploration and Prospecting for Radioactive minerals		

Course	UNIT	REMOTE SENSING & COMPUTATIONAL GEOLOGY	Credits	L / Week
PSGE33	I	Concepts of Remote Sensing, Electromagnetic Energy	4	8
	II	Energy interactions with earth surface features		
	III	Digital Image Processing		
	IV	Introduction and scope of statistical and mathematical applications in geology 'C' Sharp Program Format; JAVA Programming techniques related to geological problems		

		*Minimum 50% of enrolled students must opt for any one of the course for a class strength of 10 students and maximum student opted the elective subject will be consider for that academic year.	Credits	L / Week

Course	UNIT	ELECTIVE I: OCEANOGRAPHY		
PSGE34	I	Origin of Oceans	4 Credits	8L / Week
	II	Marine Provinces		
	III	Ocean Circulation		
	IV	Waves Currents and Beaches		
		OR		
	UNIT	ELECTIVE I: PLATE TECTONICS		
	I	Concept of Plate tectonics		
	II	Continental drift and associated landforms		
	III	Mechanism of plate movements and ocean floor spreading		
	IV	Orogeny and Neotectonics		
		OR		
	UNIT	ELECTIVE I: MARINE GEOLOGY		
	I	Ocean Currents		
	II	Landforms of the Oceans		
	III	Ocean Floor and Tectonics		
	IV	Ocean sediments and mineral resources		

SEMESTER III

PRACTICAL

Course	Title	Credits	L / Week
PSGE3P1	HYDROGEOLOGY	4	8
PSGE3P2	GEOPHYSICAL AND GEOCHEMICAL METHODS OF PROSPECTING		
PSGE3P3	REMOTE SENSING AND COMPUTATIONAL GEOLOGY		
PSGE3P4	ELECTIVE		

DETAILED Syllabus Semester III

COURSE CODE	UNIT	Title	Credits	L / Week
		HYDROGEOLOGY		
PSGEL31	I	**Introduction to Hydrogeology** The hydrogeologic cycle Formation of aquifer systems and tyoes Occurrence and movement of groundwater, flownet analyses	4	8
	II	**Properties of rocks and groundwater** Hydrologic properties of rocks and their measurements Fluctuation of groundwater levels and causes Recharge and discharge of groundwater		
	III	**Groundwater Exploration** Groundwater exploration by geologic, hydro geologic, remote sensing and geophysical methods. Well hydraulics, tube well drilling techniques, designing, development and pumping tests.		

	IV	**Chemical properties of groundwater** Groundwater chemistry and quality analysis Groundwater resources of India, salinity, water logging and causes of water table declination and deterioration of water quality.		

COURSE	UNIT	Title	Credits	L / Week
CODE		GEOPHYSICAL AND GEOCHEMICAL METHODS OF PROSPECTING		
PSGE32	I	**Introduction and application** Geophysics in oil and mining industry Relationship between exploration geophysics and basic sciences; Various methods of exploration for various minerals and their application; Methods of geophysical modelling and selection of exploration methods	4	8
	II	**Gravity exploration** Fundamental principles of gravity prospecting Earth's gravity and concept of		

	isostasy Instruments, field measurements and interpretation
III	**Seismic Prospecting Electrical prospecting methods** Seismic waves and types, Seismic wave propagation Seismic reflection and refraction methods Instruments and field measurements Processing and interpretation of seismic data. Applications in petroleum industry **Electrical prospecting methods** Self-potential method and equipotential line method Resistivity method Telluric currents and naturally alternating magnetic fields Induced polarization method
IV	**Magnetic Exploration and Prospecting for Radioactive minerals** Fundamental principles of magnetic prospecting Earth's magnetism Instruments, field measurements and

		interpretation Introduction to airborne magnetic survey **Prospecting for Radioactive minerals** Fundamentals of radioactivity and detection of radiation Common radioactive minerals and prospecting techniques Examples of radioactivity survey		

COURSE	UNIT	Title	Credits	L / Week
CODE		REMOTE SENSING & COMPUTATIONAL GEOLOGY		
PSGEL33	I	**Concepts of Remote Sensing:** Concepts and Foundations of Remote Sensing, Energy Sources and Radiation Principles **Airborne platforms and Space borne platforms** - Sun synchronous and Geostationary satellites **Electromagnetic Energy** : EM Spectrum, EM Radiation **Energy interactions in the Atmosphere**: Scattering, Absorption. **Sensors and Sensor Materials**-Multi Spectral Sensing, Thermal Remote Sensing; Hyperspectral Remote Sensing.	4	8
	II	**Energy interactions with earth surface features**: Spectral Reflectance of Vegetation, Soil and Water, **Spectral response patterns** - Atmospheric Influences on Spectral Response Patterns.		
	III	**Digital Image Processing :** Image Rectification and Correction; Enhancement Techniques, Classification Techniques Accuracy Assessment		

	IV	**Introduction and Scope of** statistical and mathematical applications in geology. Data collection and preparation. Testing hypothesis. Temporal and spatial data analysis. **'C'** or C Sharp **Program Format**: C or C Sharp Keywords; Basic data types Programming Languages C or C Sharp ; Parameters, Variables, operators, constants, Data Types intermixing, Input Output Routines, Arrays **Control Flow statements in 'C' or** C Sharp ; Functions; Pointers; Structures; Files **Basic Java:** Introduction and Applications; Java Language Fundamentals; Control Structures; Threads; Exception Handling; Input Output Package		

COURSE	UNIT	Title	Credits	L / Week
CODE		ELECTIVE : OCEANOGRAPHY		
	I	**Origin of the Oceans** Evidence for plate tectonics; Plate boundaries;		2

PSGEL34		Mid-oceanic ridges an mantle convection; Sea floor spreading	4	
	II	**Oceanography: Marine provinces:** bathymetry provinces of the ocean floor; **Marine sediments:** Classification of sediments; Neritic deposits; Pelagic deposits; Surface marine resource; Subsurface marine resource		2
	III	**Ocean circulation** Surface currents; Upwelling and down welling; surface currents of the oceans; Deep currents		2
	IV	**Waves, Currents and Beaches** Wave characteristics; Wind generated waves; Beaches and shoreline processes; Estuaries, Wetlands Lagoons		2

COURSE	UNIT	Title	Credits	L / Week
CODE	ELECTIVE : PLATE TECTONICS			
	I	**Concept of Plate tectonics** Concept of tectonics on a sphere, mechanism of plate tectonics Plates and plate boundaries. Relative and absolute plate motions		2

PSGEL34	II	**Continental drift and associated landforms** Ocean ridges. Continental drift. Hot spot and mantle plumes Subduction zones. Transform and Transcurrent faults.	4	2
	III	**Mechanism of plate movements and ocean floor spreading** Driving mechanism for plate movement , Marine magnetic anomalies and sea floor spreading		2
	IV	**Orogeny and Neotectonics** Mountain Belts and Orogeny; Evolution of Cratons; Indicators of Neotectonic movements		2

COURSE	UNIT	Title	Credits	L / Week
CODE	ELECTIVE: MARINE GEOLOGY			
PSGEL34	I	**Ocean Currents** Waves, currents, Catastrophic waves from the sea Beaches, Continental Shelves	4	8
	II	**Landforms of the oceans** Continental slopes, Trenches & Canyons		
	III	**Ocean floor and tectonics** Deep ocean floor and various topographic features-		

		ridges, sea mounts, Coral reefs		
	IV	**Ocean sediments and mineral resources** Sediments, mineral deposits of sea bed Man & ocean		

PRACTICAL

	Course	Title	Credits	L / Week
PSGE3P12	PSG3P31	Hydrogeology : Groundwater flow net construction and interpretations; Graphical plotting and interpretation of chemical quality data of waters; Analysis of aquifer test data; Problem solving on groundwater recharge, groundwater volume, balance	4	8
	PSG3P32	Geophysical Prospecting Problems and maps related with gravity, electrical and seismic prospecting.		

	Course	Title	Credits	L / Week
PSGE3P$_{34}$	PSG3P$_{33}$	**Remote Sensing** **Study and Visual Interpretation** of Satellite data (Coarse Resolution to fine Resolution), **Photogrammetric measurements and problems** based on (Scale, Height, stereo Parallax etc.). **Digital Image Processing analysis:** Creating Spatial and non-spatial (attribute) data. (Creating Polygon, line and point vectors; attribute data table; etc.). Correcting errors, structure and restructure of data.	4	8
	PSG3P$_{34}$	Problems based on Elective		

Recommended References

HYDROGEOLOGY

1. Todd D.K. Groundwater hydrology, Johm Wiley, NY, 1980
2. Raghunath, H.M. Ground Water, New Age International Publishers, 2007
3. Davis and De Wiest, Hydrogeology
4. Coates, D.R. Environmental Geology, John Wiley, 1981

GEOCHEMICAL AND GEOPHYSICS METHODS OF EXPLORATION

1. Fundamentals of geophysics by William Lowrie,Cambridge university press, 1997
2. An introduction to exploration geophysics by Kearey and Brooks,Blackwell scientific publication, 198
3. Geophysical methods in geology by Sharma PV. Elsevier, 1986
4. An introduction to geophysical prospecting by Dobrin M.B., McGraw Hill New Delhi, 1984
5. Outline of geophysical prospecting by Ramachandra Rao, M.B, Wesley press, 1975.

COMPUTATIONAL GEOLOGY

1. Davis, J. C.: Statistical methods in Geology, J Wiley Publ.
2. Programming in C
3. Programming in Java

REMOTE SENSING, DIP and GIS

1. Sabins: Remote Sensing - Principles and Interpretation 3rd Ed. Freeman
2. Jensen Introductory Digital Image Processing- A Remote Sensing Perspective. 2nd Ed. Prentice Hall
3. Lillesand, Kiefer and Chipman Remote sensing and Image Interpretation. Fifth Ed. Wiley and sons.
4. Ravi P. Gupta: Principles of Remote Sensing. Springer-Verlag
5. Longley, Geographic Information Systems and Science, 2nd Ed. WILEY, 2003
6. Burrough, P.A. An Introduction to GIS, 1996
7. P. A. Burrough, Principles of Geographical Information systems for Land Resource assessment, Clarendon Press, Oxford. 2001
8. Chang, K. Introduction to Geographic Information Sc., McGraw Hill, 2002.

OCEANOGRAPHY

1. Shepard P.P. (1983), Submarine geology
2. Thurman H.V (1983) Essentials of Oceanography

PLATE TECTONICS

1. Fowler, C.M.R.(2005) The Solid Earth: An introduction to Global Geophysics, 2nd edition, Cambridge University Press, UK
2. Pickard, G.K. & Emeegy, W.J; (1982) Physical Oceanography
3. Lerman, A., (1979) Geochemical Processes water & sediment environment. John Wiley

MARINE GEOLOGY

1. Shepard, Submarine geology
2. King, Introduction to marine geology and geomorphology
3. James Kennet, Marine geology, 1982, prentice hall
4. Riley and Chester, Introduction to marine chemistry

M.Sc. – II SEMESTER IV
GEOLOGY Syllabus

THEORY

Course	Unit	Environmental Geology	Credits	L/Week
PSGEL41	I	Introduction	4	4
	II	Soil and Soil Contamination		
	III	Natural Hazards		
	IV	Waste and Pollution Management		

Course	Unit	Tectonics and Geomorphology	Credits	L/Week
PSGEL42	I	Introduction to Tectonic Geomorphology	4	4
	II	Tools and Techniques of Measurement		
	III	Paleoseismology		
	IV	Applications on different timescales		

PSPRJ3		Project + Black Book	12	

PRACTICAL

PSGE4P41	I	Environmental Geology	2	4
PSGE4P42	II	Tectonics and Geomorphology	2	4

THEORY

Course	Unit	Title	Credits	L/Week
Environmental Geology				
PSGEL41	I	Introduction Definition; History of Environmental Geology; Environmental Geology and Commercial reality. Environmental legislation Problems of urbanization, human population and their impact on the environment. Urban	4	4

		Environments: Urban planning and geology		
	II	**Soil and Soil Contamination** Processes of soil formation, soil Profile, types of soils, soil degradation and changing land use pattern. Soil Contamination Due To Urbanization, industrialization and mining.		
	III	**Natural Hazards** Exogenic hazards and Endogenic hazards. Distribution, magnitude and intensity of earthquakes. Seismic hazard zones. Landslide, Floods and volcanic hazards: their causes and control. Coastal erosion: its causes and control. Engineering geology in extreme events		
	IV	**Waste and Pollution Management** Waste management and geological environment; Waste and Pollution; Waste and Society; Wastes in open dumps; Landfilling wastes; Effluent		

		treatment and disposal; Waste gases and the atmosphere; Radioactive wastes and management		

Course	Unit	Title	Credits	L/Week
Tectonics and Geomorphology				
PSGEL42	I	Introduction to Tectonic Geomorphology Introduction: The need to study geomorphology quantitatively; Models of landscape development; Rates of erosion and denudation: Definitions, tectonic denudation versus geomorphic erosion, calculation of minimum eroded volume Modern controversies in tectonic geomorphology Geomorphic markers: (a) Planar markers-Marine terraces, river terraces, raised beaches and shorelines and (b) Linear markers-rivers, ridge	4	4

		crests, moraine, manmade features		
	II	**Tools and Techniques of Measurement** Dating methods: a) Relative dating methods - Weathering rinds, Soil development, Carbonate coatings, Lichenometry, b) Absolute dating methods - U/Th dating, Paleomagnetic, Luminescence dating etc. Introduction to Geodesy, Methods of measurement-Alignment arrays and trilateration arrays, precise leveling, tropical coral, GPS and RADAR interferometry, LIDAR imaging		
	III	**Paleoseismology** The earthquake cycle and alternative earthquake models Fault growth; Geomorphic expression of faults; Relationship between folds and faults; Models of folding; Fold growth. Seismic moment and moment magnitudes; Direct and indirect observations of faulting - Trenching,		

		displacement of landforms, stratigraphic evidence, Tree rings, Rock falls.		
	IV	**Applications on different timescales** Holocene deformation: River base level and knickpoints, channel patterns and characteristics Late Cenozoic time scale: (a) Climate-tectonic interactions-The Himalayan case, Alpine glacial buzzsaw model, (b) dynamic topography-continental scale tilting of the Australian plate		

PRACTICAL

	Course	Title	Credits	L / Week
PSGE4P12	PSGE4P1	• Preparation of maps of seismic, landslide zonation and flood prone areas of India. • Preparation of World distribution maps of volcanoes and earthquakes. • Analyses for alkalinity, acidity, pH and	4	8

		conductivity (electrical) in Soil samples.		
	PSGE4P2	• Exercises on mapping of tectonic geomorphological features • Morphometric analysis: mountain-front sinuosity, hypsometric curve and hypsometric integral, drainage basin asymmetry, stream-length gradient index, and valley-floor width to valley height ratio • Computation of geomorphic indices using remote sensing data • Problems related to isostasy and flexural rebound • Problems related to different dating methods		

SCHEME OF EXAMINATION PROGRAM

M.Sc. II Semester III and IV

THEORY EXAMINATION

I. INTERNAL (Continuous Assessment: Class Test, Poster Paper review): 40 Marks

a. Concept Poster OR Review of Research Paper OR Presentation (20)
b. Written Test : (20)

2. END SEMESTER:

Theory End Semester Question Paper: 60 Marks, $2^{1}/_{2}$ hours duration

Instruction to Examiners: There will be 5 QUESTIONS of 12 MARKS each
Instruction to Candidates: All questions are Compulsory

Questions will be set from all topics for 12 MARKS with INTERNAL options and 100% choice not exceeding 16 or18 marks
Question 1 based on unit 1
Question 2 based on unit 2
Question 3 based on unit 3
Question 4 based on unit 4
Question 5 based on units 1 to 4

Dissertation:

The dissertation will be based on the field data collected and the results obtained. The student is expected to submit a report of up to 53 pages

Project Report	= 200 marks
Project (VIVA)	= 100 marks

	= 300 marks

Recommended References

Environmental Geology

1. Valdiya, K.S. (1987) Environmental Geology – Indian Context. Tata McGraw Hill
2. Keller, E.A. (1978) Environmental Geology, Bell and Howell, USA
3. Bryant, E. (1985) Natural Hazards, Cambridge University Press
4. Patwardhan, A.M. (1999) The Dynamic Earth System. Prentice Hall
5. Subramaniam, V. (2001) Textbook in Environmental Science, Narosa International
6. Bell, F.G. (1999) Geological Hazards, Routledge, London
7. Smith, K. (1992) Environmental Hazards. Routledge, London

Tectonics and Geomorphology

1. Tectonic Geomorphology by Burbank and Anderson, Wiley-Blackwell Publishers.
2. Active Tectonics: Earthquakes, Uplift and Landscapes by Keller and Pinter, Prentice Hall Publishers.
3. Active Tectonics and Alluvial Rivers by Schumm, Dumont and Holbrook, Cambridge University Press.
4. Tectonically Active Landscapes by Bull, Wiley-Blackwell Publishers.
5. Tectonic Geomorphology of Mountains: A new approach to paleoseismology by Bull, W . (2007), Blackwell Publishing