

# **MAHATMA GANDHI UNIVERSITY**

## **B. Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**

**(MODEL III)**

### **SCHEME AND SYLLABUS**

**(UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM)**

2017

**PREPARED BY BOARD OF STUDIES AND  
FACULTY OF SCIENCE (UG)**

**MAHATMA GANDHI UNIVERSITY**

**PRIYADARSHINI HILLS P. O.**

**KOTTAYAM, KERALA 686 560, INDIA**

**[www.mgu.ac.in](http://www.mgu.ac.in)**

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\* Geology is offered only as Core Course for B.Sc. Geology Program and Vocational Core for B.Sc. Geology and Water Management Program

## **1. Acknowledgement**

The support and guidance from various eminent personalities made this restructuring of B. Sc. Geology and Water Management syllabus under CBCS 2017 is a success. I place on record my gratitude to the Hon. Vice Chancellor and Pro - Vice Chancellor of Mahatma Gandhi University, Kottayam for the initiative and guidance in restructuring the syllabus. I express profound gratitude to the members of the University Syndicate and Academic council for fruitful steering of the program.

I also thankful to members of Faculty of Science and Board of Studies in Geology for their support and guidance. Administrative support from the Registrar and his office is thankfully acknowledged. Thanks to Academic and the Finance Sections for prompt response to solve technical snags.

I also grateful to all teachers who participated in the workshop organized by the University for restructuring the syllabus. I extend my gratitude to all professionals, academicians and other stakeholders who gave valuable suggestions in this regard.

Dean - Faculty of Science

Mahatma Gandhi University Kottayam

## **2. Introduction**

The Mahatma Gandhi University resolved to introduce Choice Based Credit System (CBCS) from the Academic Year 2017-18 onwards in tune with directives of the University Grants Commission to implement uniform grading system in universities. The primary aim of CBCS is to facilitate mobility of students across institutions within the country and abroad. The draft syllabus was modified by incorporating suggestions from participants in the workshop.

## **3. Aims and Objectives**

The B. Sc. Geology and Water Management programme is designed to:

1. Provide basic knowledge of different branches of Geology at graduate level.
2. Understand the Earth and its various processes, both external and internal that shape it.
3. Assess the Earth as source of natural resources such as water, minerals, rocks, ores, coal and oil and devise ways and means to extract these for benefit of mankind.
4. Realize the threat of natural disasters and work out ways to mitigate its effects.
5. Recognize the Earth as an environmental realm and chalk out plans for conserving its resources.

## **4. Duration of Program**

Duration of program will be 6 semesters spread over 3 academic years. See Section 5.1 to 5.3 of University Regulation for details.

**MAHATMA GANDHI UNIVERSITY**  
**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**  
**(2017 ADMISSION ONWARDS)**  
**FIRST SEMESTER (Duration: 18 weeks)**

Sl. No	Course Category	Title with Course Code		Contact Hours/week	Credits	Mark	
						External	Internal
1	Common Course I: <b>English</b>	Paper I		5	4	80	20
2	Complimentary I <b>Mathematics</b>	Mathematics I:  <i>Course Code:</i>		4	3	80	20
3	Complimentary II <b>Chemistry</b>	Chemistry Theory	Chemistry I:  <i>Course Code:</i>	2	2	60	15
		Chemistry Practical	Chemistry Practical <i>(Practical sessions in First Semester; Practical examination in Second Semester)</i>	2	--	--	--
4	Core : <b>Geology</b>	Geology: Theory	<b>Methodology and Perspectives in Geology</b> <i>Course Code: GL1CRT01</i>	2	2	60	15
		Geology Practical	<b>Physical Geology and Geomorphology</b> <i>(Practical sessions in First Semester; Practical examination along with that of Second Semester i.e. GL2CRP01)</i>	2	--	--	--
6	Vocational Core:  <b>Water Management</b>	Water Management: Theory	Introduction to Water Management <i>Course Code: GW1VOT01</i>	4	3	80	20
7		Water Management: Theory	Groundwater Hydrology <i>Course Code: GW1VOT02</i>	4	4	80	20
<b>Total for First Semester</b>				<b>Hours/Week 25</b>	<b>Credits 18</b>	<b>Ext 440</b>	<b>Int 110</b>
						<b>Total: 550</b>	

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**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**  
**(2017 ADMISSION ONWARDS)**  
**SECOND SEMESTER (Duration: 18 weeks)**

Sl. No	Course Category	Title with Course Code		ContactHours/week	Credits	Mark	
						Ext ern al	Internal
1	Common Course I: <b>English</b>	Paper II		5	4	80	20
2	Complimentary I <b>Mathematics</b>	Mathematics II: <i>Course Code:</i>		4	3	80	20
3	Complimentary II <b>Chemistry</b>	Chemistry: Theory	Chemistry II: <i>Course Code:</i>	2	2	60	15
4		Chemistry : Practical	Chemistry Practical <i>(Examination inclusive of First Semester topics)</i> <i>Course Code:</i>	2	2	40	10
5	Core <b>Geology</b>	Geology: Theory	<b>Geomorphology</b> <i>Course Code: GL2CRT02</i>	2	2	60	15
6		Geology : Practical	<b>Physical Geology and Geomorphology</b> <i>(Practical Examination inclusive of First Semester topics)</i> <i>Course Code: GL2CRP01</i>	2	2	40	10
7	Vocational Core:  <b>Water Management</b>	Surface Water Hydrology & Water Resources of India <i>Course Code: GW2VOT03</i>		4	4	80	20
8		Groundwater Exploration and Management <i>Course Code: GW2VOT04</i>		4	4	80	20
<b>Total for Second Semester</b>				<b>Hours/ Week 25</b>	<b>Credits: 23</b>	<b>Ext 520</b>	<b>Int 130</b>
						<b>Total: 650</b>	

**MAHATMA GANDHI UNIVERSITY**  
**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**  
**(2017 ADMISSION ONWARDS)**  
**THIRD SEMESTER (Duration: 18 weeks)**

Sl. No	Course Category	Title with Course Code	ContactHours/week	Credits	Mark	
					External	Internal
1	Complimentary I <b>Mathematics</b>	Mathematics III: <i>Course Code:</i>	5	4	80	20
2	Complimentary II <b>Chemistry</b>	Chemistry – III: <i>Course Code:</i>	3	3	60	15
3		Chemistry Practical <i>(Practical sessions in Third Semester; Practical examination in Fourth Semester)</i>	2	--	--	--
4	Core: <b>Geology</b>	Core: Theory Crystallography and Physical Mineralogy <i>Course Code: GL3CRT03</i>	3	2	60	15
		Core: Practical Crystallography and Mineralogy <i>(Practical sessions in Third Semester; Practical examination along with that of Fourth Semester i.e. GL4CRP02)</i>	2	--	--	--
5	Vocational Core:  <b>Water Management</b>	Irrigation and Hydropower <i>Course Code: GW3VOT05</i>	5	4	80	20
6		Water Supply Engineering <i>Course Code: GW3VOT06</i>	5	4	80	20
<b>Total for Third Semester</b>			<b>Hours/Week 25</b>	<b>Credits 17</b>	<b>Ext 360</b>	<b>Int 90</b>
					<b>Total: 450</b>	

**MAHATMA GANDHI UNIVERSITY**  
**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**  
**(2017 ADMISSION ONWARDS)**  
**FOURTH SEMESTER (Duration: 18 weeks)**

Sl. No	Course Category	Title with Course Code	Contact Hours/week	Credits	Mark	
					External	Internal
1	Complimentary I <b>Mathematics</b>	Mathematics IV: <i>Course Code:</i>	5	4	80	20
2	Complimentary II <b>Chemistry</b>	Chemistry IV: <i>Course Code:</i>	3	3	60	15
3		Chemistry Practical II <i>(Examination inclusive of Third Semester topics)</i> <i>Course Code:</i>	2	2	40	10
4	Core: <b>Geology</b>	<b>Mineralogy</b> <i>Course Code: GL4CRT04</i>	3	2	60	15
5		<b>Crystallography and Mineralogy</b> <i>Course Code: GL4CRP02</i> <i>(Examination inclusive of Third Semester topics)</i>	2	2	40	10
6	Vocational Core: <b>Water Management</b>	Theory Water Management <i>Course Code: GW4VOT07</i>	6	4	80	20
7		Practical Water Management <i>Course Code: GW4VOP01</i>	4	2	80	20
<b>Total for Fourth Semester</b>			<b>Hours/ Week 25</b>	<b>Credits 19</b>	<b>Ext 440</b>	<b>Int 110</b>
					<b>Total: 550</b>	

**MAHATMA GANDHI UNIVERSITY**  
**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM (2017**  
**ADMISSION ONWARDS)**  
**FIFTH SEMESTER (Duration: 18 weeks)**

Sl. No.	Course Category	Title with Course Code	Contact Hours/Week	Credits	Mark	
					External	Internal
1	Core: <b>Geology</b> Theory	Stratigraphy and Sedimentary Petrology <i>Course Code: GL5CRT05</i>	4	4	60	15
2		Igneous Petrology <i>Course Code: GL5CRT06</i>	4	4	60	15
3		Metamorphic Petrology and Geochemistry <i>Course Code: GL5CRT07</i>	4	4	60	15
4		Environmental Geology <i>Course Code: GL5CRT08</i>	4	4	60	15
5	<b>Open Course</b> Theory (Other Stream)	<b>Understanding the Earth</b> <i>Course Code: GL5OPT01</i>	4	3	80	20
6	Core: <b>Geology</b> Practical	<b>Petrology</b> ( <i>Practical sessions in Fifth Semester; Practical examination in Sixth semester i.e., GL6CRP03</i> )	4	--	--	--
7	Vocational Core: <b>Water</b> Management	Crop Water Management <i>Course Code: GW5VOT08</i>	1	1	80	20
<b>Total for Fifth Semester</b>			<b>Hours/Week</b> 25	<b>Credits</b> 20	<b>Ext</b> 400	<b>Int</b> 100
					<b>Total: 500</b>	

**MAHATMA GANDHI UNIVERSITY**  
**SCHEME OF B.Sc. GEOLOGY AND WATER MANAGEMENT PROGRAM**  
**(2017 ADMISSION ONWARDS)**  
**SIXTH SEMESTER (Duration: 18 weeks)**

Sl. No.	Course Category	Title with Course Code	Contact Hours/Week	Credits	Mark	
					External	Internal
1	Core: <b>Geology</b> Theory	Structural Geology <i>Course Code: GL6CRT09</i>	4	4	60	15
2		Phanerozoic Stratigraphy of India <i>Course Code: GL6CRT10</i>	4	3	60	15
3		Palaeontology <i>Course Code: GL6CRT11</i>	4	3	60	15
4		Economic Geology <i>Course Code: GL6CRT12</i>	4	4	60	15
5	Core: <b>Choice Based</b> <b>Optional:</b> Theory (any one to be opted in Sixth Semester)	Geotectonics and Precambrian Stratigraphy of India <i>Course Code: GL6CBT01</i>	4	3	80	20
		Marine Geology <i>Course Code: GL6CBT02</i>				
		Remote Sensing and GIS <i>Course Code: GL6CBT03</i>				
6	Core: <b>Geology</b> Practical	Petrology ( <i>Practical sessions in Fifth Semester; Practical examination in Sixth Semester ie. GL6CRP03</i> )	See syllabus of Fifth Semester See syllabus of Fifth Semester	2	80	20
7		Structural Geology, Economic Geology & Paleontology <i>Course Code: GL6CRP04</i>	5	2	80	20
8	Study Tour-cum-Geological Field Work (Geological field work and specimen collection) Mark awarded for report of geological field work done during study tour and display of geological specimens collected during field work <i>Course Code: GL6STP01</i>		*See note given here under	1	40	10
9	Project Report <i>Course Code: GW6PRP01</i>			1	40	10
<b>Total for Sixth Semester</b>			<b>Hours/Week</b> <b>25</b>	<b>Credits</b> <b>23</b>	<b>Ext</b> <b>560</b>	<b>Int</b> <b>140</b>
					<b>Total: 700</b>	

**\*NOTE:** Three (3) study tours for geological field work, including specimen collection, and submission of tour report is an integral, mandatory component of the program. These study tours are to be scheduled during:

1. **First or second semester**, with emphasis on physical Geology and Geomorphology: (5 to 8days, restricted to South India)
2. **Third or fourth semester**, with emphasis on Mineralogy (5 to 8 days, restricted to South India)  
**Fifth or sixth semester**, with emphasis on Petrology, Stratigraphy, Structural Geology and Economic Geology, including visit to mines and academic/research institutions: (10 to 15 days, covering North India)

Collective report of these study tours should be submitted in the sixth semester and specimens collected during field work should be displayed at the time of practical examination in the sixth semester. Mark and credit for these two will be awarded in the sixth semester.

# MAHATMAGANDHIUNIVERSITY

First Semester B.Sc. Geology (Model I)

First Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)  
SYLLABUS OF CORE COURSE – Theory 1 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
I	2 Hours	36 Hours	3 Hours	15	60	75	2

## GL1CRT01: METHODOLOGY AND PERSPECTIVES IN GEOLOGY

**Unit I** Geosciences- introduction to various branches - Physical Geology, Geomorphology, Mineralogy, Structural Geology, Petrology, Global tectonics, Palaeontology, Stratigraphy, Engineering Geology, Marine Geology, Geochemistry, Applied Geophysics, Geochemistry, Hydrogeology, Meteorology, Oceanography, Remote Sensing, Environmental Geology, Disaster Management and Economic Geology. The concept of rock cycle. **(6 Hrs)**

**Unit II** Theories of origin of Earth. Earth - Shape, size, age and rotation. Internal structure of earth; crust, mantle, core; density and chemical composition; major seismic discontinuities. Basic Concepts of Geological Time Scale. **(6 Hrs)**

**Unit III** Endogenic processes: Plate Tectonics. Continental drift hypothesis and Sea floor spreading-evidences. Lithospheric plates, types of plate boundaries, plate movements and associated geological features, mid-ocean ridges, rift valleys, trenches, transform faults, island arcs, volcanic arcs, Benioff zones, mantle plumes, aseismic ridges. Mountains-Types and origin. Isostasy. **(10 Hrs)**

**Unit IV** Volcanoes and their classification. Volcanic eruption- types, products, effects. Global distribution of volcanoes. **(6 Hrs)**

**Unit V** Earthquakes - types and causes, propagation of seismic waves, focus and epicenter, elastic rebound theory, seismograph and seismogram. Intensity and magnitude of earthquakes, effect of earthquakes, seismic belts of the world, Earthquake hazard zonation of India. **(8 Hrs)**

### References

1. Arthur Holmes, Principles of Physical Geology (Edinburgh: Thomas Nelson and Sons, 1944 and New York: Ronald Press, 1945).
2. Strahler, Arthur Newell, The Earth Sciences, New York, Harper & Row
3. Carlson, Plummer and McGeary: Physical Geology – Earth Revealed, Published by McGraw-Hill, 2006
4. Carlson, Plummer and Mc Geary: Introductory Geology – Earth Revealed, Published by McGraw-Hill.
5. Press and Siever, Understanding Earth, W. H. Freeman; 4 edition, 2003
6. Ernst W. G., Earth Systems: Processes and Issues, Cambridge University Press, 2000.
7. Frederick K. Lutgens, Essentials of Geology (11th Edition) Pearson Prentice Hall, Pearson Education, Inc. New Jersey 2012

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**MAHATMA GANDHI UNIVERSITY**  
 First Semester B. Sc. Geology (Model I)  
 First Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)  
**SYLLABUS OF CORE COURSE – Practical 1 (Common Syllabus to both Programs)**

**SYLLABUS OF CORE COURSE (PRACTICAL) 1**

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Interna	External	Total	
I	2 Hours	36 Hours	Exam in II Sem	--	--	--	Nil

**(Note: Practical sessions in First semester; Practical examination in Second semester)**

**GL2CRP01: PHYSICAL GEOLOGY**

Clinometer and Brunton Compass- Map orientation, Elements of map reading, fore bearing and back bearing.

Topographic sheets: scale, legends- types and categories, interpretation of contours and identification of natural landscape elements, scale measurements, slope calculation. Determination of latitude and longitude from toposheets, measurement of distance between two points.

Construct sketches, cutaway section of earth and earth spheres, Plate boundaries.

Determination of epicentre of an earthquake.

Stereoscope and stereo-pairs – identification of landforms.

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# MAHATMA GANDHI UNIVERSITY

First Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE – Theory1

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
I	4 Hours	72 Hours	3 hours	20	80	100	3

### GW1VOT01: Introduction to Water Management

**Unit 1** Introduction to hydrologic cycle–Processes of hydrologic cycle- Precipitation- Forms of precipitation (Drizzle- Rain- Glaze- Sleet- Snow- Snowflakes- Hail) Run-off - Factors affecting Run-off– Infiltration - Evaporation- Transpiration- Evapotranspiration- Condensation. **(14 hrs)**

**Unit 2** Factors influencing climate and weather - Temperature- Pressure- Humidity- Cloud- Wind Direction and Velocity .Climatic zones classification by Koppen and Thornthwaite. Cloud classification (brief study only)- low cloud- precipitating cloud- middle cloud- high cloud. **(14 hrs)**

**Unit 3** Water harvesting Methods– Surface and Groundwater Harvesting- Farm ponds- Check dams- Artificial recharge- Subsurface dams- Rain water harvesting. Nomenclature of traditional Water harvesting structures in different Ecological zones of India- Rain water as a resource of water –Methods of rain water harvesting- Traditional techniques and modern methods of rain water harvesting. Roof water harvesting– Insitu water harvesting. **(14 hrs)**

**Unit 4** Wetlands: Benefits of wetland-General classification of wetlands- Classification of wetlands of India – importance of wetlands in ground water replenishing– role of wetlands in drought/flood. Influence of wetland on climate change- Major threats to wetland– Important wetlands in World- Major Wetlands in India – Wetlands in Kerala. Ramsar Convention– Issues and development/conservation activities observed by Ramsar convention. Ramsar sites of India. **(16 hrs)**

**Unit 5** Development and management of water resources - Concept of water resource development-Role of water in India’s developments – natural and artificial barriers in water resource development. Impact of rainfall, flood, drought, dams, pollution, urbanization, over exploitation in Water resource Management. Critical water resource zones in India and Kerala. **(14 hrs)**

### References

3. Alan P. Trujillo and Harold V. Thurman. Essentials of Oceanography.
4. Ravi P. Gupta, Remote sensing Geology, Springer publication.
5. Karanth K. R. Ground Water Assessment Development and Management Tata McGraw Hill Publishing Company Ltd.
6. R. N. Athalve, Water harvesting and sustainable supply in India. Rawat publication
7. Dr. B. C. Punmia and Dr. Pande B. B. Lal. Irrigation and Water Power Engineering, Laxmi Publication.
8. Steven A. Ackerman and John A. Knox, Meteorology, Jones and Bartlett Learning publications USA.

# MAHATMA GANDHI UNIVERSITY

First Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE – Theory2

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
I	4 Hours	72 Hours	3 hours	20	80	100	4

### GW1VOT02: Groundwater Hydrology

**Unit 1** Hydrological cycle; Occurrence of groundwater; Groundwater recharge; Factors governing groundwater storage and movement- Porosity- types and Permeability- types; Sources of groundwater- meteoric, connate and juvenile water **(14 hrs)**

**Unit 2** Vertical distribution of ground water- zones of aeration and saturation- watertable; Aquifers- types- confined, unconfined, leaky and idealized; Aquiclude, Aquitard, Aquifuge; Perched water table; Cone of depression. **(14 hrs)**

**Unit 3** Basic definitions- Specific yield, specific retention, storage coefficient, hydraulic conductivity and transmissibility; Groundwater potential and flow rate-Darcy's law and velocity. **(14 hrs)**

**Unit 4** Groundwater contamination- municipal, industrial, agricultural and miscellaneous sources; maintaining groundwater quality- cleaning contaminated aquifers- natural groundwater purification; Salt water intrusion- sources, Ghyben Herzberg relation, upconing, control methods. **(14 hrs)**

**Unit 5** Threats to the groundwater supply- groundwater depletion, salt water intrusion and land subsidence; Artificial recharge- concept and methods- basin, stream channel, ditch and furrow, flooding, irrigation, pit, recharge well methods. **(16 hrs)**

### References

1. David Keith Todd, Ground Water Hydrology, John Wiley and Sons
2. William C. Walton, Ground Water Resources Evaluation, McGraw Hill
3. Reghunath H. M., Ground Water Wiley Eastern Ltd.
4. Karanth K. R., Ground Water Assessment Development and Management Tata McGraw Hill Publishing Company Ltd.

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# MAHATMA GANDHI UNIVERSITY

Second Semester B. Sc. Geology (Model I)

Second Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

SYLLABUS OF CORE COURSE – Theory 2 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
II	2 Hours	36 Hours	3 hours	15	60	75	2

## GL2CRT02: GEOMORPHOLOGY

**Unit I** Exogenic Processes: Weathering - factors, types and products of weathering. Physical and chemical processes. Soil, factors affecting soil formation and soil profile. Laterite. Mass wasting - types, causes and control. **(6 Hrs)**

**Unit II** Geological agents. Cycle of erosion. Streams – Stream as a geological agent. Drainage basin and drainage pattern. Stream erosion, transportation and deposition. Development and evolution of fluvial landforms- different stages of fluvial evolution- youth, mature and old age stages. **(8 Hrs)**

**Unit III** Hydrologic cycle. Origin and occurrence of groundwater. Water table, types of aquifers. Groundwater as a geological agent- erosional and depositional features. Karst topography, stalagmite, stalactite, caves. **(6 Hrs)**

**Unit IV** Oceans- salinity of ocean water. Waves, currents and tides. Coastal erosion, transportation and deposition. Classification of coastlines and coastal morphology. Eustatic sea level changes. Physiographic features of ocean floor: continental shelf, continental slope, continental rise, submarine canyons, abyssal plains, MORs, deep sea trenches, guyots, seamounts. Coral reefs- types, their formation and distribution. **(8 Hrs)**

**Unit V** Glaciers– Formation, movement and morphology. Types of glaciers. Erosion, transportation and deposition by glaciers. Glacial landforms. Global warming and its effects on glaciers. Geological action of winds. Landforms of Aeolian origin. **(8 Hrs)**

### References

1. Ahamed E. (1972) Coastal Geomorphology of India. Orient Longman, New Delhi.
2. Thornbury W. D. (1968). Principles of Geomorphology, Wiley.
3. Plummer Carlson, Mc Geary (2003).Physical Geology. McGraw–Hill.
4. Weisberg J, and Parish, H. (1974). Introductory Oceanography. McGraw Hill.
5. Arthur Holmes, Principles of Physical Geology (Edinburgh: Thomas Nelson and Sons, 1944 and New York: Ronald Press, 1945.
6. Bloom A, Geomorphology– A Systematic analysis of Late Cenozoic Landforms (Third edition) Wavel and Press Inc.
7. Kale Vishwas S, Gupta. Introduction to Geomorphology, Orient Black Swan (2000)
8. Sparks B. W. Geomorphology, Longmans (1969)

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MAHATMA GANDHI UNIVERSITY  
 Second Semester B. Sc. Geology (Model I)  
 Second Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)  
 SYLLABUS OF CORE COURSE– Practical 1 (Common Syllabus to both Programs)

**Core Practical 1: GL2CRP01 PHYSICAL GEOLOGY AND GEOMORPHOLOGY**

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
II	2 Hours	36 Hours	3 Hours	10	40	50	2

**Part A: PHYSICAL GEOLOGY**

Note: See syllabus of First semester Core Practical ‘Physical Geology’. Practical sessions conducted in First Semester. Practical examination conducted as combined single examination as **Physical Geology and Geomorphology** in Second Semester.

**Part B: GEOMORPHOLOGY**

Study of toposheets to identify different drainage pattern and its illustration.

Delineation of drainage basins and identification of stream order in toposheets and their illustration.

Identification and representation of different landforms in toposheets.

Schematic representation of evolution of fluvial landform through youth, mature and old stages Diagrammatic representation of evolution of meandering stream, hydrologic cycle, drainage network and sand dunes.

Preparation of thematic maps (drainage, contour, landuse, landforms, slope) from toposheets.

Morphometric analysis of drainage basins- stream ordering, drainage frequency, drainage density, bifurcation ration and relief ratio.

Preparation of profile from contour maps and topo sheets

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# MAHATMA GANDHI UNIVERSITY

Second Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE – Theory 3

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
II	4 Hours	72 Hours	3 hours	20	80	100	4

### GW2VOT03: Surface Water Hydrology and Water Resources of India

**Unit 1** Hydrosphere- Components of Hydrosphere. Brief study of Streams, lagoonsbackwaters, springs (Hot springs- Fumaroles- Geysers- Formation of springs- Uses) and Ocean as a resource of water. Physical and chemical properties of Ocean water- Ocean Oscillations- Gyre- Ekman spiral- Upwelling- El Nino- La Nina- Cyclones (formation and structure). Types of Cyclones. **(14 hrs)**

**Unit 2** Runoff: factors affecting runoff, computation of runoff, Hydrograph–components ofhydrograph– unit hydrograph: assumptions, Stream flow: measurement- area velocity method. **(14 hrs)**

**Unit 3** Rivers of India: Classification of different types of river basins–Major Riversystems of India - the Ganges, the Indus, the Brahmaputhra and the Godavari. Conflicts over trans-boundary water resources. **(14 hrs)**

**Unit 4** Surface water resources of Kerala–rivers, backwaters, lakes and estuaries–major rivers of Kerala. **(14 hrs)**

**Unit 5** Floods and droughts: Flood frequency analysis, design flood- Flood routing- Floodcontrol– structural measures– reservoirs, levees, flood walls, flood ways and channel improvement– non-structural measures– evacuation, flood proofing, land management, flood plain management, meteorological, agricultural and hydrological droughts- proneness to floods and droughts: criteria adopted by India Meteorological Department and Central Water Commission. **(16 hrs)**

#### References

1. William C. Walton, Ground Water Resources Evaluation, McGraw Hill Kogakuzhalid
2. Reghunadh H. M. Ground Water Wiley Eastern Ltd.
3. Karnath K. R. Ground Water Assessment Development and Management  
McGraw Hill Publishing Company Ltd.
4. Alan P. Trujillo and Harold V. Thurman Essentials of Oceanography, PHI Learning  
Pvt. Publications.

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# MAHATMA GANDHI UNIVERSITY

Second Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE –Theory 4

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
II	4 Hours	72 Hours	3 hours	20	80	100	4

### **GW2VOT04: Groundwater Exploration and Management**

**Unit 1** Water wells- different types- open, bored, tube and filter point well; Test holes; Well logs; Methods of construction of shallow wells and deep wells; Horizontal wells- surangam, horizontal pipes, infiltration galleries and collector wells. **(14 hrs)**

**Unit 2** Well completion- casing, cementing, screens and gravel pack; Well development- pumping, surging, surging with air, backwashing with air, hydraulic jetting and use of chemicals; Well rehabilitation. **(14 hrs)**

**Unit 3** Investigation of groundwater- Surface investigation- geologic, geomorphologic, remote sensing and geophysical methods- electric resistance, seismic refraction, gravity and magnetic methods. **(16 hrs)**

**Unit 4** Subsurface investigation- logging methods- geologic log, drilling time log, resistivity log, spontaneous potential log, caliper log and radiation log- natural gamma, gamma gamma and neutron log; Water witching. **(14 hrs)**

**Unit 5** Groundwater level fluctuations- due to stream flow, evapotranspiration, meteorological phenomenon, tides and urbanization; Groundwater level measurement; Kerala groundwater control and regulation act 2003; Management of groundwater. **(14 hrs)**

### **References**

1. David Keith Todd, Ground Water Hydrology, John Wiley and Sons
2. William C. Walton, Ground Water Resources Evaluation, McGraw Hill
3. Reghunath H. M. Ground Water Wiley Eastern Ltd.
4. Karnath K.R. Ground Water Assessment Development and Management Tata McGraw Hill Publishing Company Lt

# MAHATMA GANDHI UNIVERSITY

Third Semester B. Sc. Geology (Model I)

Third Semester B.Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CORE COURSE– Theory 3 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
III	3 Hours	54 Hours	3 hours	15	60	75	2

### GL3CRT03: CRYSTALLOGRAPHY AND PHYSICAL MINERALOGY

**Unit I** Significance of crystallography in mineralogy. Elements of crystallography: crystalline state and crystals. Morphology of crystals, faces, edges, vertex, forms and zones. Crystal angles– plane angles, interfacial angles and solid angles; Contact Goniometer, Law of Constancy of Interfacial Angles. External symmetry elements in crystals. Crystallographic axes: choice of axes, labeling and orientation. Classification of crystals into systems and classes. Nomenclature of crystal faces: intercepts, parameters, unit face, Weiss notation, Miller indices. Law of crystal indices, axial ratio. Brief study of holohedral, hemihedral, hemimorphic and enantiomorphic forms. **(14 hrs)**

**Unit II** Systematic crystallography: The study of symmetry, simple forms and combinations of the following crystal classes.  
Isometric system- Normal, tetrahedral, pyritohedral and plagiohedral classes. **(10 hrs)**  
Tetragonal system- Normal, tripyramidal and sphenoidal classes.

**Unit III** Hexagonal system- Hexagonal Division: Normal, tripyramidal, trapezohedral classes. Rhombohedral Division: Rhombohedral, trirhombohedral and trapezohedral classes. Orthorhombic system- Normal, hemimorphic and sphenoidal classes. **(10 hrs)**

**Unit IV** Monoclinic system- Normal class. Triclinic system- Normal class.  
Twinning in crystals- Twin laws, elements of twinning, twinaxis, twin plane, composition plane and important examples of twinning. Brief study of morphological imperfections in crystals.  
Basic concepts of spherical and stereographic projections in crystallography, Wulff net, projection of symmetry elements of Isometric system Normal Class. **(10 hrs)**

**Unit V** Mineral- definition of Mineral and Mineraloid, scope and aim of Mineralogy. Physical mineralogy: physical properties of minerals- form, habit, cleavage, fracture, color, diaphaneity, luminescence, fluorescence, phosphorescence, play of colours, luster, streak, hardness, specific gravity. Electrical, magnetic and radioactive properties of minerals. **(10 hrs)**

#### References

1. Dana: A text book of Mineralogy- Asia Publishing House.
2. Phillips: An Introduction to Crystallography– Longmans Green
3. Read: Rutley's elements of mineralogy- Thomas Murby
4. Mason and Berry: Elements of Mineralogy - Freeman
5. Klein and Hurlbut– Manual of Mineralogy – John Wiley

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# MAHATMA GANDHI UNIVERSITY

Third Semester B. Sc. Geology (Model I)

Third Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

SYLLABUS OF CORE COURSE – Practical 2 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
III	2 Hours	36 Hours	Exam in IV Sem	--	--	--	Nil

**(Note: Practical sessions in Third semester; Practical examination in Fourth semester)**

## **GL4CRP02: CRYSTALLOGRAPHY AND MINERALOGY**

Drawing of symmetry elements of normal classes of all systems. Identification and description of the following crystal models.

Isometric system: Galena, Garnet, Spinel, Magnetite, Fluorite, Sphalerite, Tetrahedrite, Pyrite and Cuprite.

Tetragonal system: Zircon, Cassiterite, Rutile, Apophyllite, Wulfenite, Chalcopyrite.

Hexagonal system: Beryl, beta quartz, Calcite, Tourmaline, Alpha quartz.

Orthorhombic system: Barite, Olivine, Topaz, Sulphur, Staurolite.

Monoclinic system: Gypsum, Orthoclase, Augite, Hornblende.

Triclinic: Axinite, Albite, Kyanite.

Twin crystals: Spinel, Fluorite, Rutile, Calcite, Quartz, Staurolite, Aragonite, Gypsum, Augite, Orthoclase, Albite.

Determination of physical properties of minerals- form, habit, cleavage, fracture, color, luster, streak, hardness and specific gravity.

### **GUIDE LINES FOR PRACTICAL EXAMINATION- QUESTION PAPER**

#### **CRYSTALLOGRAPHY AND MINERALOGY**

1. Identification of crystal models and write the symmetry elements
2. Identification of crystal models and write the forms present
3. Write the face symbols and Miller indices of crystal models
4. Identification of type of twinning in crystal models
5. Identification of form/habit present
6. Identification of crystal system of minerals
7. Identification of type of cleavage and/or fracture
8. Identification of luster
9. Identification of color and streak
10. Identification of most important distinguishing physical properties

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# MAHATMA GANDHI UNIVERSITY

Third Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE –Theory 5

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
III	5 Hours	90 Hours	3 hours				4
				20	80	100	

### **GW3VOT05: Irrigation and Hydropower**

**Unit 1** Introduction to irrigation-Necessity of Irrigation, Scope of Irrigation, Benefits of irrigation, ill-effects of irrigation, types of irrigation systems: Flow Irrigation, Perennial, Inundation, Direct/Diversion Scheme, Storage scheme, combined storage and Diversion scheme; Lift Irrigation. **(20 hrs)**

**Unit 2** Irrigation methods: classification of irrigation method- surface irrigation methods; Flooding: wild flooding, controlled Flooding: Contour farming, Furrow Irrigation: free flooding, contour laterals, border strips; check flooding, basin flooding, zigzag method- subsurface irrigation methods: natural, artificial methods- sprinkler and drip irrigation- advantages and limitations. **(20 hrs)**

**Unit 3** Quality of irrigation water–Water requirement of crop–Standards of irrigation water -physical and chemical parameters: soluble salt concentration, salt concentration, sodium concentration, boron content. **(20 hrs)**

**Unit 4** Irrigation canals-Canal classification- nature of supply: permanent, inundation- financial output: productive and protective canals-functions of canals: irrigation canal, carrier canal, feeder canal, navigation canal, power canal- canal alignment: ridge/watershed canal, contour canal, slide slop canal– Inundation canals- Bandhara irrigation- Phad system of irrigation. **(15 hrs)**

**Unit 5** Hydropower- Principal components of hydroelectric power scheme–Fore bay, intake structure, surge tanks, penstocks, power house, turbines, generators, transformers, transmission lines. Merits and demerits of hydropower plants. **(15 hrs)**

### **References**

1. Mujumdar: Irrigation Water management- Prentice Hall of India Pvt Ltd.
2. Modi: Irrigation, Water Resources and Water Power Engineering - Standard Book House Delhi
3. Punmia and Lal: Irrigation and water Power Engineering, Laxmi Publications
4. Arora, Irrigation: Water Power and Water Resources Engineering- Standard Publishers , Distributors, Delhi
5. Hillier and Leiberman L: Introduction to Operations Research -McGraw Hill Publishing Company
6. Ravidran, Phillips and Solberg: Operations Research- Principles and practices. John Wiley and Sons

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# MAHATMA GANDHI UNIVERSITY

Third Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE –Theory 6

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
III	5 Hours	90 Hours	3 hours	20	80	100	4

### **GW3VOT06: Water Supply Engineering**

**Unit I** Water demand and quantity: Rate of water demand-consumption for various purposes, per capita demand, and design period - population forecast: arithmetical increase, geometrical increase, incremental increase, and decreased rate of growth, graphical and zoning method. **(20 hrs)**

**Unit II** Water supply system: 1: Requirements- source, Surface Source. Underground sources- collection of surface water; intake-location, types: river intake, reservoir intake, canal intake. **(20 hrs)**

**Unit III** Water supply system 2: Transmission of surface water: gravity conduits and pressure conduits-various pipe materials. Water distribution: requirements of distribution system- methods of distribution: gravity, pumping, combined gravity and pumping system. **(20 hrs)**

**Unit IV** Water supply system 3: Service reservoirs: surface reservoirs, elevated reservoirs - balancing reservoirs-systems of supply; continuous, intermittent system-layout of distribution system: dead end, grid-iron, circular and radial system-wastage of water-prevention. **(20 hrs)**

**Unit V** Appurtenances in the distribution system– Fire Hydrants– Water meters– Stop Cocks– water taps and Bib cocks– Pipe fittings– Plumbing system in water supply and associated terms– The House water connection. **(10 hrs)**

### **References**

1. Punmia & Jain: Environmental Engineering Vol.I&II. Laxmi Publications NewDelhi (1998)
2. Lal and Upadhyay: Water Supply and Wastewater Engineering - Kataria & Sons, Delhi (2002)
3. Duggal: Elements of Public Health Engineering- S. Chand and Company Ltd. New Delhi
4. Garg and Garg: Environmental Engineering Vol I & II - Khanna Publishers, Delhi (2002)
5. Raju: Water Supply and Waste water Engineering - Tata McGraw Hill Publishing Company Ltd. New Delhi (1995)
6. Manual on Water Supply and treatment–Ministry of Urban Development (MUD) India (1999)

# MAHATMA GANDHI UNIVERSITY

Fourth Semester B. Sc. Geology (Model I)

Fourth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CORE COURSE – Theory 4 (Common syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
IV	3 Hours	54 Hours	3 hours	15	60	75	2

### GL4CRT04: MINERALOGY

**Unit I Optical Mineralogy:** Ordinary and polarized light, polarization of light, refractive index, critical angle and total internal reflection. Polarization by reflection, absorption, refraction. Double refraction, construction of Nicol prism. Isotropic and anisotropic substances. Petrological microscope- parts and functions. Optical accessories- mica plate, gypsum plate and quartz wedge. Birefringence, uniaxial and biaxial minerals, optic sign, relief, pleochroism, interference colour and its order, extinction. Basic description of indicatrix. **(15 hrs)**

**Unit II Chemical Mineralogy:** Polymorphism, isomorphism, pseudomorphism, solid solution and exsolution in minerals. **(3 hrs)**

**Unit III Descriptive Mineralogy:** Classification of minerals. Rock forming and ore forming minerals. Silicates- Structure and classification of silicate minerals. Physical, chemical and optical properties of the following: olivines, garnets, pyroxenes amphiboles, micas, feldspars, feldspathoids, quartz. **(14 hrs)**

**Unit IV** Systematic study of andalusite, sillimanite, kyanite, epidote family, beryl, cordierite, tourmaline, clay minerals, zeolite group, calcite and dolomite. **(8 hrs)**

**Unit V** Systematic study of the important non-silicate minerals- diamond, graphite, sulphur, gold, silver, copper, realgar, orpiment, stibnite, molybdenite, cinnabar, sphalerite, galena, chalcocopyrite, pyrite, magnetite, hematite, marcasite, barite, gypsum, halite, fluorite, corundum, cuprite, chromite, rutile, cassiterite, ilmenite, monazite, psilomelane, pyrolusite, goethite, limonite, bauxite, aragonite, magnesite, malachite and azurite. **(14 hrs)**

### References

1. Dana- A textbook of mineralogy– Asia Publishing House, Wiley.
2. Read- Rutley's elements of mineralogy–Thomas Murby &Co.
3. Mason and Berry- Elements of Mineralogy–W. H. Freeman &Co.
4. Deer, Howie and Zussman- An introduction to rock forming minerals. Longmans.
5. Berry, Mason, Dietrich - Mineralogy, CBS Publication
6. Klein and Hurlbut–Manual of Mineralogy, John Wiley & Sons
7. Winchell and Winchell- Optical Mineralogy
8. William D. Nesse- Introduction to Mineralogy, Oxford University Press.

# MAHATMA GANDHI UNIVERSITY

Fourth Semester B. Sc. Geology (Model I)

Fourth Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

## SYLLABUS OF CORE COURSE– Practical 2 (Common Syllabus to two Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
IV	2 Hours	36 Hours	3 hours				2
				10	40	50	

### GL4CRP02: CRYSTALLOGRAPHY AND MINERALOGY

#### PART A: CRYSTALLOGRAPHY

Note: See syllabus of Third semester Core Practical ‘Crystallography and Physical Mineralogy. Practical sessions conducted in Third Semester. Practical examination conducted as combined single examination as **Crystallography and Mineralogy** in Fourth Semester.

#### PART B: MINERALOGY

##### Megascopic study and identification of following minerals:

Quartz, smoky quartz, milky quartz, amethyst, chalcedony, agate, jasper, chert, opal, orthoclase, microcline, plagioclase, perthite, nephelene, leucite, enstatite, bronzite, hypersthene, diopside, augite, wollastonite, anthophyllite, tremolite, actinolite, hornblende, olivine, serpentine, muscovite, biotite, vermiculite, phlogopite, chlorite, epidote, garnet, natrolite, stilbite, apophyllite, talc, gypsum, apatite, steatite, andalusite, kyanite, sillimanite, staurolite, cordierite, apatite, beryl, topaz, calcite, dolomite, tourmaline, zircon, fluorite, magnetite, hematite, chromite, sphalerite, psilomelane, pyrolusite, graphite, corundum.

(14 hrs)

##### Microscopic study of following minerals:

Quartz, microcline, orthoclase, albite, oligoclase, labradorite, nephelene, leucite, enstatite, hypersthene, augite, diopside, hornblende, tremolite, actinolite, anthophyllite, biotite, muscovite, olivine, epidote, diopside, garnet, chlorite, cordierite, andalusite, sillimanite, kyanite, staurolite, calcite, apatite, zircon, tourmaline.

(22 hrs)

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# MAHATMA GANDHI UNIVERSITY

Fourth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE – Theory 7

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
IV	6 Hours	108 Hours	3 hours				4
				20	80	100	

### GW4VOT07: Water Supply Management

**Unit I Quality of water:** Reason for analysis of Water -sampling and preservation of water for test- analysis of water: physical, chemical and bacteriological test. **(30 hrs)**

**Unit II Water treatment 1:** Sedimentation tanks: purpose-fill and draw type and continuous type tanks-rectangular and circular continuous flow tanks - Sedimentation aided with coagulation: coagulation and flocculation-common coagulants. **(24 hrs)**

**Unit III Water treatment 2:** Filtration: Theory of filtration- types: slow sand filter and rapid sand filter –essential features, working, cleaning, efficiency, uses and other appurtenances. **(24 hrs)**

**Unit IV Water treatment 3:** Disinfection: necessity- minor methods of disinfection- chlorination- Disinfecting action of chlorine – application and forms of chlorination. **(30 hrs)**

**Unit V Water pollution control:** Sources of water pollution; natural and artificial- types of water pollution; physical, chemical and biological pollution- effects of pollution- preventive measures, water borne diseases. **(24 hrs)**

#### References

1. Punmia and Jain. Environmental Engineering Vol I&II Laxmi Publications New Delhi (1998)
2. Lal & Upadhyay: Water Supply and Wastewater Engineering. Kataria&Sons, Delhi, (2002)
3. Duggal, Elements of Public Health Engineering S. Chand and Company Ltd. New Delhi
4. Garg and Garg. Environmental Engineering Vol I & II, Khanna Publishers Delhi (2002)
5. Raju - Water Supply and Wastewater Engineering Tata McGraw Hill Publishing Company Ltd. New Delhi (1995)
6. Manual on Water Supply and treatment – Ministry of Urban Development (MUD) India (1999)

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**MAHATMA GANDHI UNIVERSITY**  
Fourth Semester B.Sc. Geology and Water Management(UGC Vocational-Model III)

**SYLLABUS OF VOCATIONAL CORE PRACTICAL 1**

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
IV	4 Hours	72 Hours	3 hours				2
				20	80	100	

**GW4VOP01: Hydro Geochemistry**

1. Water Quality Analysis
  - (i) Ph, Temperature, Acidity, Alkalinity, Turbidity
  - (ii) Solids- Total dissolved solids
  - (iii) Hardness, Conductivity, Chloride, Calcium and Magnesium
2. Quality analysis of Rain water, well water, Ground water, streams, lakes, reservoirs and pipe water.
3. Schematic drawing of methods (Natural & Man-made) and models of rain water harvesting- Field visit and preparation of report.

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# MAHATMA GANDHI UNIVERSITY

Fifth Semester B. Sc. Geology (Model I)

Fifth Semester B. Sc. Geology and Water Management (UGC Vocational - Model III)

## SYLLABUS OF CORE COURSE –Theory 5 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
V	4 Hours	72 Hours	3 hours	15	60	75	4

### GL5CRT05: STRATIGRAPHY AND SEDIMENTARY PETROLOGY

**Unit I** Definition and scope. Brief study of the guiding principles/laws of Stratigraphy (Principles of uniformitarianism; superposition; cross-cutting relationships; original horizontality; truncation; included fragments; and faunal succession). Concept of stratum, its delineation and general nomenclature.

Concept of facies: lithofacies and biofacies. Concept of breaks in stratigraphic records: Unconformities, diastems, hiatus - overlap and offlap. **(15 hrs)**

**Unit II** Concept of geological column and geological time scale. Principles of lithostratigraphy, biostratigraphy and chronostratigraphy and hierarchy of their units. Principles and methods of local and regional correlation. **(15hrs)**

**Unit III** Origin of sediments. Diagenesis- Compaction, cementation, authigenesis, recrystallization and replacement. Classification of sedimentary rocks– Clastic and non-clastic rocks. Clastic texture-concept of size, Udden-Wentworth and Phi scale scheme. Grain shape, morphology and fabric. Non-clastic texture – different types of crystalline texture. Brief study of the following: Primary, secondary and organic structures. **(15 hrs)**

**Unit IV** Categorization of mechanical rocks: Argillaceous, arenaceous and rudaceous rocks. Introduction to the following: sandstone, shale, conglomerate and breccia. **(12 hrs)**

**Unit V** Introduction to limestone, Classification of limestone– Folk and Dunham scheme. Brief study of the following chemical and biochemical sedimentary rocks: Calcareous, ferruginous, siliceous, phosphatic and evaporates. **(15 hrs)**

### References

1. Dunbar & Rogers - Principles of Stratigraphy. Willey.
2. Krumbein & Sloss - Stratigraphy and Sedimentation. Freeman.
3. Tyrrel - Principles of Petrology, Asia Publishing House.
4. Huang - Petrology, MC Graw Hill.
5. Pettijhon - Sedimentary Rocks, Harper & Bros.
6. Harker - Petrology for Students, Cambridge.
7. Folk – Sedimentology, Hemphils
8. Greensmith - Sedimentary Petrology

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# MAHATMA GANDHI UNIVERSITY

Fifth Semester B. Sc. Geology (Model I)

Fifth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

SYLLABUS OF CORE COURSE – Theory 6 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
V	4 Hours	72 Hours	3 hours	15	60	75	4

## GL5CRT06: IGNEOUS PETROLOGY

**Unit I** Rock- definition, types, rock cycle, plutonic, hypabyssal and volcanic igneous rocks. Origin of magma; primary and parental magmas. Cooling history of igneous rocks, melting and crystallization. Bowen's reaction series. Study of following binary systems: Diopside-Anorthite (Eutectic), Albite-anorthite (solid solution), Forsterite-silica (Incongruent), Albite-orthoclase (solvus). **(12 hrs)**

**Unit II** Petrotectonic settings, partial melting and magma generation (mid oceanic ridges and subduction zones only), Diversity of igneous rocks- magmatic differentiation process, fractional crystallization, liquid immiscibility and assimilation/contamination. **(16 hrs)**

**Unit III** Forms of Intrusive igneous rocks: Concordant forms- sill, laccolith, lopolith and phaccolith. Discordant forms - dykes, cone sheets, volcanic neck, ring dyke, batholiths, stocks, bosses and bysmaliths. Forms of extrusive igneous rocks: lava flows, pyroclastic deposits - agglomerate, lapilli, volcanic ash and pumice. **(14 hrs)**

**Unit IV** Igneous structures: Vesicular and amygdaloidal structures, blocky lava, ropy lava, pillow structure, flow structure, sheet joints, mural jointing, and columnar jointing. Textures: definition and description; Crystallinity- crystallites, microlites, devitrification; Granularity- absolute and relative grain size; Shapes of crystals; Mutual relations- Equigranular textures: allotriomorphic, hypidimorphic, Panidiomorphic, Inequigranular textures: porphyritic and poikilitic textures, Intergrowth texture- perthite, antiperthite, graphic, vermicular textures, Overgrowth textures- orbicular structure, Reaction textures- coronas, Directive textures - trachytic texture, spherulitic structure and perlitic fracture. **(16 hrs)**

**Unit V** Classification: bases of classification- texture, mineralogy and chemistry. Classification based on mineralogy - felsic and mafic minerals, mode, colour index and IUGS classification - QAP classification of plutonic & volcanic rocks and ultramafic rock classification.

Chemical classification - Based on silica saturation and based on alkali & silica (brief introduction of alkalic, subalkalic, calc-alkalic and tholeiitic groups only) - Total alkali vs silica classification for volcanic rocks. A short account of CIPW norm and normative minerals.

Texture, mineralogy, classification, occurrence and origin of granites and basalts. Brief petrographic character of common igneous rocks- syenite, diorite, gabbro, andesite, rhyolite, pegmatites, lamprophyres, carbonatite, dunite, peridotite, anorthosite and kimberlite. **(14 hrs)**

## References

1. Tyrrell: Principles of Petrology. Chapman and Hall Ltd., London.
2. Bowen: The Evolution of the Igneous Rocks. Dover publication, Inc, New York.
3. Barth: Theoretical Petrology. Wiley.
4. Walstrom: Theoretical Igneous Petrology, Wiley.
5. Turner and Verhoogen: Igneous and Metamorphic Petrology. Mc Graw Hill.
6. Hatch and Wells: Petrology of Igneous Rocks. Thomas Murby & Wells, M.K. (Publ.)
7. Johannesen: Descriptive Petrography of Igneous Rocks, Vols. I to IV. Allied Pacific.
8. Wilson: Igneous Petrogenesis. Unwin Hyman Inc., USA.
9. John D. Winter (2012) Introduction to Igneous and metamorphic Petrology

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# MAHATMA GANDHI UNIVERSITY

Fifth Semester B. Sc. Geology (Model I)

Fifth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)  
SYLLABUS OF CORE COURSE – Theory 7 (Common Syllabus to two Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
V	4 Hours	72 Hours	3 Hours	15	60	75	4

## GL5CRT07: METAMORPHIC PETROLOGY AND GEOCHEMISTRY

**Unit I** Definition of metamorphism. Factors of metamorphism - pressure, temperature, chemically active fluids, time and parent rock chemistry. Pressure temperature limits of metamorphism. Anatexis, palingenesis and migmatites. Metasomatism. (12 hrs)

**Unit II** Types of metamorphism– Contact metamorphism, Regional metamorphism – orogenic & ocean floor, Burial metamorphism, Cataclastic metamorphism, hydrothermal metamorphism Impact/shock metamorphism and plutonic metamorphism. Metamorphism associated with convergent and divergent plate margins. (12 hrs)

**Unit III** Metamorphic grade concept. Progressive and retrogressive metamorphism. Stability of minerals in P-T field. Metamorphic mineral zone concept- index minerals & Isograd, Barrovian metamorphic zone, metamorphic paragenesis, Goldschmidt's mineralogical phase rule. Metamorphic facies concept. Metamorphic differentiation, Concept of geothermobarometry. (15 hrs)

**Unit IV** Metamorphic textures – Crystalloblastic and Relict textures. Metamorphic structures– foliations, lineations, cataclastic and miscellaneous. Metamorphism of pelitic, carbonate and mafic rocks. Petrography of the following metamorphic rocks: slate, phyllite, quartzite, marble, schists, amphibolite, gneisses, eclogite, blueschist, mylonite, hornfels and granulites - charnockite (massive, incipient), khondalite & leptynite. (15 hrs)

**Unit V** Geochemistry: Metallic, Co-valent, Ionic and Van der Waals Bonding in Minerals. Geochemical classification of elements: lithophile, chalcophile, siderophile, atmophile. Eh-pH in geological environment. Major elements in rocks and use of variation diagrams. (18 hrs)

### References

1. Winter - Textbook of Igneous and Metamorphic Petrology. Prentice Hall.
2. Winkler - Petrogenesis of Metamorphic Rocks, 5th, 6th and 7th eds. Springer Verlag.
3. Yardley - Textbook of Metamorphic Petrology. ELBS, London.
4. Turner & Verhoogen - Igneous and Metamorphic Petrology, McGraw Hill.
5. Williams, Turner & Gilbert – Petrography. Freeman.
6. Mason – Geochemistry, John Wiley.
7. Tyrrel - Principles of Petrology. Asia Publishing House.
8. Krauskopf – Geochemistry

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**MAHATMA GANDHI UNIVERSITY**  
 Fifth Semester B.Sc. Geology (Model I)  
 Fifth Semester B.Sc. Geology and Water Management (UGC Vocational-Model III)  
**SYLLABUS OF CORE COURSE-Theory8 (Common Syllabus to both Programs)**

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
V	4 Hours	72 Hours	3 Hours	15	60	75	4

**GL5CRT08: ENVIRONMENTAL GEOLOGY**

**UNIT I:** Environmental Geosciences – Concept, definition, scope and importance. Role of Geology in environmental studies. The physical environment - Atmosphere, hydrosphere, lithosphere and biosphere. Anthropogenic environment. **(14hrs)**

**UNIT II:** Natural Resources - Renewable and non-renewable. Conservation and preservation of non-renewable resources. Environmental Hotspots. Global warming – Greenhouse effect and ozone depletion. **(14 hrs)**

**UNIT III:** Environmental pollution – water and air pollution - causes and effect. Heavy metal pollution in ground water. Health hazards due to groundwater pollution. Solid waste management. Concept of sustainable development. Environmental laws. **(12 hrs)**

**UNIT IV:** Environmental Consequences of natural hazards - Earthquake, Flood, Tsunami, Landslide and Draught. Impact of mining on environment. Brief description of Environmental Impact Assessment – EIA. **(14 hrs)**

**UNIT V: Human Rights** – An Introduction to Human Rights, meaning, concept and development. History of Human Rights- Different generations of Human Rights- Universality of Human Rights- Basic International Human Rights documents-UDHR, ICCPR, ICESCR – value dimensions of Human Rights

**Human Rights and United Nations** - Human Rights co-ordination with UN system- Role of UN secretariat- The Economic and Social Council – The Commission of Human Rights- The Security Council and Human Rights -The committee on the elimination of the Racial discrimination - The Committee on the elimination of discrimination against Women- The committee on Economic, Social and Cultural Rights - The Human Rights Committee – Critical Appraisal of UN Human Rights Regime.

**Human Rights National Perspective** – Human Rights in Indian Constitution – Fundamental Rights- The Constitutional context of Human Rights- Directive principles of state policy and Human Rights – Human Rights of women – children- minorities- prisoners-Science Technology and Human Rights –

National Human Right Commission – State Human Right Commission – Human Right awareness in education. (18 hrs)

### References

1. Valdia K.S (1987) Environmental Geology – Indian Context –Tata Mc Graw Hill
2. Geomorphology and Environmental Geo science. Willey international
3. Donald R Coates, 1981, Environmental Geology, John Wiley and sons
4. Peter T Elawan ,1970. Environmental Geology, Harper & Row
5. Keller E.A (1978) environmental Geology –Bell &Howell USA
6. Bryante (1985) Natural Hazards Cambridge University Press.
7. Basic Documents in Human Rights – Ian Brownlie
8. Universal Human Rights in Theory and Practice - Jack Donnelly
9. Future of Human Rights – Upendra Baxi
10. Understanding Human Rights An Overview- OP Dhiman
11. Reforming Human Rights- D P Khanna
12. Human Rights in India Historical Social and political Perspectives – Chiranjivi J Nirmal
13. Human Rights in Post-colonial India – Ed. Om Prakash Dwivedi and V G Julie Rajan

**MAHATMA GANDHI UNIVERSITY**  
 Fifth Semester B. Sc. Geology (Model I)  
 Fifth Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)  
 (Common Syllabus to both Programs)

**OPEN COURSE - THEORY (FOR STUDENTS OF OTHER STREAMS)**

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
V (Open Course)	4 Hours	72 Hours	3 Hours	20	80	100	3

**GL5OPT01: UNDERSTANDING THE EARTH**

**Unit I** Introduction to Geology – branches of Geology. The earth: size, shape, density, volume and internal structure. Hydrologic Cycle, Groundwater – infiltration, zones of groundwater, ground and perched water tables, open and bore wells, natural and artificial recharge.

**(14 hrs)**

**Unit II** Exogenic processes: Weathering - agents, types and products of weathering. Mass wasting– types, Landslides.

**(14 hrs)**

**Unit III** Endogenic processes: Volcanoes - types and distribution of major volcanoes. Products of volcanism – volcanic gas, dusts, lava and pyroclastics. Earthquakes - seismic waves and propagation, epicenter and focus, intensity and magnitude scales, seismographs and seismogram, Tsunami.

**(16 hrs)**

**Unit IV** Minerals– definition, salient physical properties – habit, color, streak, luster, cleavage and hardness. General classification of minerals - rock forming and economic minerals with common examples.

**(14 hrs)**

**Unit V** General classification of rocks– Igneous, Metamorphic and Sedimentary with common examples. Fossils – uses, fossilization processes.

**(14 hrs)**

**References**

1. Holmes: Principles of Physical Geology
2. Strahler: Earth Sciences
3. Thornbury: Principles of Geomorphology
4. Carlson and Plummer: Physical Geology: Earth Revealed
5. Monroe and Wicander: Physical Geology
6. Klein and Hurlburt: Manual of Mineralogy
7. Anantharaman: Palaeontology
8. Gribble: Rutley's Elements of Mineralogy
9. Perkins: Mineralogy
10. Tyrrell: Principles of petrology
11. Ehlers and Blatt: Petrology

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# MAHATMA GANDHI UNIVERSITY

Fifth Semester B. Sc. Geology (Model I)

Fifth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CORE COURSE – Practical 3 (Common syllabus to both Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
V	4 Hours	72 Hours	Exam in VI Sem	20	80	100	2

(Note: Practical sessions in Fifth Semester; Practical examination in Sixth semester)

### GL6CRP03: PETROLOGY

#### Megascopic identification of the following rocks:

Mica Granite, Hornblende Granite, Graphic granite, Granite Porphyry, Pegmatite, Aplite, Syenite, Nepheline Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Basalt, Rhyolite, Felsites, Obsidian, Pumice, Scoria.

Slate, Phyllite, Schist (different types), Gneiss (different types), Quartzite, Marble, Amphibolite, Eclogite, Leptynite, Charnockite, Khondalite, Mafic Granulite, Schorl rock, Banded Magnetite Quartzite.

Conglomerate, breccia, sandstone (coarse, medium, fine), limestone (micritic, dolomitic, marl, oolitic, fossiliferous), mudstone, shale, fossiliferous shale, black shale.

#### Microscopic identification and description of the following rocks:

Mica Granite, Hornblende Granite, Graphic Granite, Granite–porphyry, Syenite, Nepheline Syenite, Diorite, Gabbro, Dunite, Pyroxenite, Dolerite, Anorthosite, Basalt,

Slate, Chlorite schist, Mica schist, Kyanite schist, Garnetiferous schist, Charnockite, Eclogite, Amphibolite, Leptynite, Khondalite, Cordierite gneiss, Garnet–sillimanite gneiss, Garnetiferous Biotite Gneiss

Sandstone (different types), limestone (different types), shale

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# MAHATMA GANDHI UNIVERSITY

Fifth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF VOCATIONAL CORE COURSE –Theory: 08

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credit
				Internal	External	Total	
V	1 Hour	18 Hours	3 hours	20	80	100	1

### **GW5VOT08: Crop Water Management**

**Unit I** Soil-water-plant relationship- soil type, composition of soil, properties of soil-colour, texture and structure, water holding and transmitting capacity, ph; Classification of soil-based on age, geologic formation, chemical composition and particle size; Soils of India. **(4 hrs)**

**Unit II** Classification of soil water- hygroscopic, capillary and gravitational water ; Soil waterconstants- saturation capacity, field capacity and wilting point; soil moisture tension; Readily available water; Depth of water held by soil root zone and available to plants. **(5 hrs)**

**Unit III** Crop water requirements–limiting soil moisture conditions, depth of water applied during irrigation and frequency of irrigation; Crop seasons and crops of India and specific to Kerala. **(3 hrs)**

**Unit IV** Crop period and base period; Duty and Delta of water- relation between duty and delta, factors affecting and improving duty of water; Irrigation efficiency; Irrigation requirement of crops, Irrigation control structures; Irrigation schedule. **(3 hrs)**

**Unit V** Rainwater harvesting - traditional and modern methods; advantages of rain water harvesting; Participatory irrigation management; Introduction of remote sensing and GIS in water resources-applications. **(3 hrs)**

### **References**

1. Mujumdar - Irrigation Water management, Prentice Hall of India Pvt Ltd.
2. Modi - Irrigation, Water Resources and Water Power Engineering Standard Book House Delhi
3. Punmia and Lal - Irrigation and water Power Engineering, Laxmi Publications
4. Arora - Irrigation Water Power and Water Resources Engineering. Standard Publishers, Distributors, Delhi
5. Hillier and Leiberman - Introduction to Operations Research. McGraw Hill Publishing Company
6. Ravindran, Phillips and Solberg, Operations Research- Principles and practices. John Wiley and Sons

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

SYLLABUS OF CORE COURSE – Theory 9 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 Hours	15	60	75	4

## GL6CRT09: STRUCTURAL GEOLOGY

**Unit I** Introduction: Attitude of planar linear structures Strike, Dip, Plunge and Pitch. Width of outcrops. Outlier and Inlier. Overlap and offlap. Rule of V's. Primary and secondary structures. Use of primary structures in determining top of beds. Unconformities. **(12 hrs)**

**Unit II** Rock deformation–Stress and strain. Stages of rock deformation. Basic concept of spherical and stereographic projections in structural geology. Wulf net and Schmidt net. **(10 hrs)**

**Unit III** Fold- Terminology. Classification of folds- Geometric and genetic. Recognition of folds in field and map. **(18 hrs)**

**Unit IV** Faults–Terminology and classification. Mechanics of faulting. Criteria for recognition of faults in field and map. **(16 hrs)**

**Unit V** Foliation–Tectonites, Compositional, Disjunctive, Continuous, Slaty cleavage, Schistosity, Flow cleavage, Fracture cleavage, Shear cleavage. Relationship of foliation with fold and shear zones.

Lineation - Discrete, constructional and mineral lineations.

Joints – Nature, origin, classification and geologic significance.

Geological mappings, Procedures and equipments in mapping. Use of Clinometer and Brunton compasses in field. **(16 hrs)**

### References

1. Billings (1974) Structural Geology. 11<sup>th</sup> edition, Prentice Hall.
2. Park R G (1997) Foundations of Structural Geology 3<sup>rd</sup>, Chapman & Hall
3. Hills Elements of Structural Geology
4. Hobbs, Means and Williams (1976). An Outline of Structural Geology. John Wiley.
5. John Robberts - Introduction to Geological Maps and Structures, Pergamon Press.
6. Ken McClay - The mapping of Geological Structures. Geological Society of London. John Wiley and Sons.
7. R J Twiss & E M Moore (2007) Structural Geology 2<sup>nd</sup> edition. Freeman & Company

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CORE COURSE – Theory 10 (Common syllabus for both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 hours	15	60	75	3

### GL6CRT10: PHANEROZOIC STRATIGRAPHY OF INDIA

**Unit I** Concept of geological time scale in relation to Indian Phanerozoic stratigraphy. Sedimentary basins of India. Geological and physiographic divisions of India. **(14 hrs)**

**Unit II** Detailed study of following Paleozoic succession of India. Cambrian of Salt range. Paleozoic of Spiti region. Gondwana supergroup – its distribution, lithology, classification, structural features and coal resources. Gondwana of east coastal region. **(18 hrs)**

**Unit III** Detailed study of following Mesozoic succession of India. Mesozoic Spiti region. Jurassic of Kutch. Cretaceous Formations in Tamil Nadu and Narmada Valley. **(14 hrs)**

**Unit IV** Detailed study of following Cenozoic succession of India. Tertiaries of Kerala and Tamilnadu. Siwalik Supergroup. Karewa Formation. Indo – Gangetic alluvium. **(12 hrs)**

**Unit V** Deccan Traps– its lithology, distribution, classification, Supra-, Infra- and intertrappeans. Hydrocarbon bearing formations of India with special reference to Cambay, Rajasthan, Bombay offshore, Cauvery, Krishna Godavari, Assam – Arakan and Tripura basins. **(14 hrs)**

### References

1. Krishnan: Geology of India and Burma, 6<sup>th</sup> Edition, CBS.
2. Wadia: Geology of India, TATA McGraw – Hill.
3. Ravindrakumar Fundamentals of Historical Geology and Stratigraphy of India
4. Pascoe: Manual of the Geology India and Burma, Govt. of India Publications.
5. Vaidyanathan and Ramakrishnan (2008) Geology of India (Vol. I & II). Geological Society of India, Bangalore.

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

SYLLABUS OF CORE COURSE – THEORY (Common Syllabus to both Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 Hours	15	60	75	3

## GL6CRT11: PALAEOLOGY

**Unit I** Life through geologic history. Scope and subdivisions of paleontology. Fossilization – methods. Concept of body fossils, trace fossils, transported fossils, leaked fossils, synthetic fossils and pseudo fossils. Taxonomy and synthetics, Binomial nomenclature. Uses of fossils. **(10 hrs)**

**Unit II** Phylum Arthropoda, Class– Trilobita - General morphology: Cephalon: glabella, facial suture, free cheek, fixed cheek, genal angle, genal spine, cranidium; thorax– pygidium, classification, geological history. **(10 hrs)**

**Unit III** Phylum Brachiopoda- General morphology, umbo, hinge line, pedicle opening, delthyrium, deltidium pseudo deltidium – Brachial skeleton – morphometric details, ornamentation, classification, geological history.

Phylum Echinodermata: Class Echinoidea- General morphology, periproct, apical system (Anus, ocular plates, Genital plates, madriporic plates), corona (Ambulacra, inter ambulacra) – peristome – Regular and irregular echinoids – classification – geological history. **(20 hrs)**

**Unit IV** Phylum Mollusca: Class Pelecypoda- General characters– umbo, Hinge line– ligament – lunule and escutcheon– adductor impressions, pallial line, pallial sinus, dental patterns, ornamentation, classification, geological history. Class Gastropoda- General morphology, shell forms, whorl, spire, spiral angle, suture, aperture, columella, umbilicus, peristome, aperture, (holostomatus and siphonostomatus), types of coiling– dextral and sinistral, ornamentation, classification and geological history. Class Cephalopoda:- General morphology, siphuncle, septa, septal necks, connecting rings, chambers, suture lines, (Nautilitic, Goniotitic, Ceratitic and Ammonitic) – shell forms – ornamentation – classification evolution, geological history- morphology of a Belemnite shell. **(22 hrs)**

**Unit V** Micropalaeontology and Palynology - an introduction. Brief account of the following plant fossils- Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepididendron and Sigillaria. **(10 hrs)**

### References

1. Woods - Invertebrate Palaeontology. Cambridge.
2. Romer - Vertebrate Palaeontology. Chicago Press.
3. Arnold - An Introduction to Palaeobotany. McGraw Hill.
4. Haq and Boersma - Introduction to marine Micropalaeontology. Elsevier, Netherlands.
5. Raup and Stanely - Principles of Palaeontology. CBS Publishers.
6. Moore, Lalicker & Fishcher - Invertebrate Fossils, Harper Brothers.
7. Shrock and Twenhofel - Principles of Invertebrate Palaeontology. Arnold Publication
8. Brasier, M.D. Microfossils, George Allen & Unwin, 1980.
10. Nield & Tucker Palaeontology –An Introduction, Pergamon Press, Oxford, England, 1985

# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CORE COURSE – Theory 12 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 Hours	15	60	75	4

### GL6CRT12: ECONOMIC GEOLOGY

**Unit I** Scope of Economic Geology. Ore and Gangue Minerals. Mineral Resources and reserves. Tenor of ores. Syngenetic and Epigenetic deposits. Strategic and Critical Minerals. **(8 hrs)**

**Unit II** Processes of formation of mineral deposits: Origin due to internal processes of  
(1) Magmatic deposits, Hydrothermal deposits and Contact metasomatic deposits  
(2) Metamorphic deposits. **(16 hrs)**

**Unit III** Processes of formation of mineral deposits: Origin due to External / Surface processes of following types of deposits -  
1. Evaporate deposits.  
2. Sedimentary deposits- mechanical concentration, residual concentration  
3. Oxidation and Supergene Sulphide enrichment.  
4. Volcanic exhalative deposits. **(18 hrs)**

**Unit IV** Metallogenic Epochs and Provinces with particular reference to India. A brief study on mode of occurrence, distribution in India and important economic uses of ore minerals of the following - Aluminium, Chromium, Gold, Iron, Copper, Lead, Manganese, Silver, Thorium, Titanium, Uranium and Zinc. Mineral resources of Kerala. **(18 hrs)**

**Unit V** Materials for Abrasives, Refractories, Ceramics and Cement. Gemstones. Fuel minerals: Coal - origin and resources in India, Petroleum – origin and brief study on petroliferous basins of India **(12 hrs)**

### References

1. Anthony M. Evans, An introduction to Ore Geology, second edition, ELBS 1980.
2. Gokhale and Rao, Ore Deposits of India.
3. Krishnaswamy, Indian Mineral Resources.
4. Mead L.Jensen and Alan M. Bateman - Economic Mineral Deposits, John Wiley & Sons Third edition, revised printing, 1981.
5. Park and Macdiarmid, Ore Deposits, Freeman, 1964.
6. Roy Chacko (ed.), Mineral Resources of Kerala. Dept of Mining and Geology 2005.
7. Soman, Geology of Kerala, Geological Society of India, second revised edition 2002.
8. Umeshwer Prasad- Economic Mineral Deposits, CBS Publishers, 1996.
9. Wadia, Minerals of India, National Book Trust, India, 5th edition, 1994.
10. Levenson, Geology of Petroleum, Mc Graw Hill, 1967.

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CHOICE BASED OPTIONAL – Theory 1 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 Hours	20	80	100	3

### GL6CBT01: GEOTECTONICS AND PRECAMBRIAN STRATIGRAPHY OF INDIA

**Unit I** Gross tectonic features of continents– orogenic belts, continental margin types, Shield areas and cratons, Rift valleys. **(12 hrs)**

**Unit II** Plate tectonics- basic concepts. Tectonic features of the ocean floor. Significance of mid-ocean ridges and Island arcs in continental growth. Plate tectonics in relation to igneous activity and metallogenesis. **(12 hrs)**

**Unit III** General study of the distribution and nomenclature of Early Precambrians of India. Major cratons and fold belts of the Indian shield. Detailed study of the lithology, classification, age, structure, syn- and post- tectonic intrusives, organic remains, radiometric age and economic resources of Dharwar Craton- Sargur Schist Complex, Peninsular Gneiss. **(18 hrs)**

**Unit IV** Gross structural features of mobile belts and high grade terrains. Charnockite–Khondalite bearing High Grade terrains of Peninsular India. Eastern Ghat belts and Southern Granulite terrain. Precambrian rocks of Kerala. **(16 hrs)**

**Unit V** General study of the distribution and nomenclature of Proterozoic successions of India and detailed study of the lithology, age, classification (lithostratigraphic), structure, associated intrusives, organic remains and economic resources of Cuddapah Supergroup and Vindhyan Supergroup. **(14 hrs)**

#### References

1. Billings: Structural Geology. 11th edition, Prentice Hall.
2. Hobbs Means and Williams (1976) An Outline of Structural Geology. John Wiley.
3. John L. Robbers - Introduction to Geological maps and Structures, Pergamon Press.
4. Ken Mc Clay-The mapping of Geological Structures, Geol Soc London, John Wiley & Sons.
5. Krishnan: Geology of India and Burma, 6th Edition, CBS.
6. Wadia: Geology of India, TATA McGraw – Hill.
7. Ravindrakumar: Fundamentals of Historical Geology and Stratigraphy of India.
8. Pascoe: A manual of the Geology India and Burma, Govt. of India Publications.
9. Vaidyanathan & Ramakrishnan: Geology of India (Vol.I&II) Geol. Soc. of India, Bangalore.
10. Soman: Geology of Kerala, Geological Society of India, Bangalore.
11. Radhakrishna: Geology of Karnataka, Geological Society of India, Bangalore
12. Sanjib Chandra, Sarkar, Anupendra Gupta, Crustal evolution and Metallogeny in India, Cambridge University Press, Delhi, India 2012.
13. Amal Das Gupta, An introduction to Earth Science, World Press Private Limited, Kolkata - 2006

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational- Model III)

## SYLLABUS OF CHOICE BASED OPTIONAL – Theory 2

(Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 hours	20	80	100	3

### GL6CBT02: MARINE GEOLOGY

**Unit I** Morphology of ocean floor- Mid oceanic ridge system, Subduction zones, island arcs, trenches, conjugate oceanic basins, seamounts, Guyots and ridges. Morphology of Indian Ocean. **(16 hrs)**

**Unit II** Distribution of temperature, salinity and density in sea water. Nutrients in sea water, Eustatic changes of sea level and their effects. **(12 hrs)**

**Unit III** Oceanographic expeditions. Ocean floor drilling programmes–ODP, DSDP & JOIDES. Ocean floor mapping- Echo sounding, multi beam survey and ROVs. Marine pollution-oil spill, algal blooms, industrial effluents. **(12 hrs)**

**Unit IV** Types of coasts and coastal geomorphology, coastal upwelling and downwelling, Turbidity currents and turbidites, Mud banks, Tides and their origin. Law of the Sea – EEZ & CRZ. **(14 hrs)**

**Unit V** Marine sediments: Classification (Lithogenous, Biogenous, Hydrogenous, Cosmogenous) and distribution. Mineral resources of the oceans - polymetallic nodules, phosphatic deposits, volcanogenic massive sulphide (VMS) deposits. **(18 hrs)**

### References

1. Pinet Paul, R. Oceanography– An Introduction to the Planet Oceanus, West Publishing Co, 1992.
2. Pond, S. and Pickard, G.L. Introductory Dynamical Oceanography, 2nd Ed., Pergamon Press, 1983.
3. King, C. A. M. Beaches and Coasts, Arnold, London, 1972.
4. Trask P. D. Recent Marine Sediments, Dever Publications, 1939.
5. Krumbein, W.C. and Pettijohn, F.J. Manual of Sedimentary Petrology, Appleton Century Co., 1938.
6. Pickering, K. T. Hiscott, R.N. and F.J. Hedn. Deep Marine Environments– clastic sedimentation and Tectonics, Unwin and Hyman, 1989.
7. Roy Chester. Marine Geochemistry, Unwin Hyman, 1990.
8. Selley, R.C Ancient Sedimentary Environments, Corwell University Press, 1972.
9. Pettijohn, F. J., Potter, P. E. and Siever, R., Sand and Sandstone, Springer Verlag, 1972
10. Shepard F.P., Submarine Geology, Harper & Row, New York, 1963.

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational - Model III)

## SYLLABUS OF CHOICE BASED OPTIONAL – Theory 3

(Common Syllabus to both Programs)

Semester	Hours/Week	Hours /Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	4 Hours	72 Hours	3 hours	20	80	100	3

### GL6CBT03: REMOTE SENSING AND GIS

**Unit I** Basic principles of remote sensing - Electromagnetic spectrum. Remote Sensing data products. Aerial photography: Types of aerial photographs-vertical/oblique/high oblique. Scale of aerial photographs. Flight plan and flight lines. Overlap and side lap. Stereoscopic vision. Stereo pair. **(8 hrs)**

**Unit II** Geotechnical and photographic elements of air photo interpretation – tone, texture, color, association, site, drainage patterns etc. Interpretation of drainage pattern and fluvial landforms. Recognition of different landforms from aerial photographs. Remote sensing sensors – passive and active sensors. Multispectral scanning-RADAR system. **(20 hrs)**

**Unit III** Indian Remote Sensing Satellites. Application of remote sensing in geologic mapping, structural mapping, mineral, groundwater exploration, geomorphologic mapping. Application of remote sensing in water pollution, marine pollution. **(20 hrs)**

**Unit IV** Geoinformatics– Definition and various disciplines constituting it. Geographic Information System (GIS) – The purpose of GIS; components of GIS; GIS software. Types of Data – Raster and Vector. **(18 hrs)**

**Unit V** Spatial data input – Digitizing paper maps. Georeferencing. Transformation and Projection. Spatial data analysis – analytical capabilities of a GIS; Overlay functions, Mapping qualitative and quantitative data. GIS Applications in Geosciences – Geology; Groundwater; Mineral Exploration; Urban planning. **(14 hrs)**

### References

1. Burrough & Mc Donnell - Introduction to Geographic Information System.
2. Anji Reddy - Remote Sensing and Geographic Information system.
3. C.P. Lo and A.K.W Yeung (2005). Concepts and Techniques of Geographic Information Systems. Prentice Hall of India.
4. Stephen Wise (2002). GIS Basics. CRC Press.
5. Paul V. Bolstad (2005) GIS Fundamentals: A First Text on Geographic Information Systems. Eider Press.
6. Tasha Wade and Shelly Sommer (2006) A to Z GIS: An Illustrated Dictionary of Geographic Information Systems ESRI Press.
7. Keith C. Clarke (2007) Getting Started With GIS. Prentice Hall.
8. Gupta, R. P. - Remote Sensing Geology.
9. Lillesand T. M. & Kiefer R.W. - Remote Sensing and Image Interpretation.
10. Ramasamy, S. M. - Remote Sensing in Geomorphology.

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# MAHATMA GANDHI UNIVERSITY

Sixth Semester B. Sc. Geology (Model I)

Sixth Semester B. Sc. Geology and Water Management (UGC Vocational-Model III)

## SYLLABUS OF CORE COURSE – Practical4 (Common Syllabus to both Programs)

Semester	Hours/Week	Hours/ Semester	Exam	Mark			Credits
				Internal	External	Total	
VI	5 Hours	90 Hours	3 Hours	20	80	100	2

### GL6CRP04: STRUCTURAL GEOLOGY, ECONOMIC GEOLOGY AND PALAEOLOGY

#### Part A: STRUCTURAL GEOLOGY

##### I. Diagrammatic illustration of -

Structural features - Attitude of beds, true and apparent dip, strike and dip symbols, rules of 'V', types of Folds, Faults, Joints and Unconformities.

##### II. Maps with suitable sections and geological descriptions

Simple horizontal beds.

Illustrating Rule of V's.

Simple dipping beds.

Simple dipping beds with intrusions

Problems involving bore-hole data, thickness, dip and apparent dip.

Dipping beds with unconformity.

Folded beds.

Maps with different types of faults.

Combination maps (Unconformity, intrusion, folds and faults) – at least 5-6 maps

##### III. Problems involving true and apparent dip, true vertical thickness and width of outcrops.

Three point problems. Stereographic projection of planar and linear features.

#### Part B: ECONOMIC GEOLOGY

##### Megascopic identification and description of Indian occurrences & uses of the following ore and industrial minerals: -

**Sulphides:** Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Chalcophyrite, Pyrite.

**Sulphates:** Barite, Celestite, Gypsum.

**Oxides:** Corundum, Hematite, Ilmenite, Magnetite, Chromite, Cassiterite, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite.

**Carbonates:** Calcite, Dolomite, Magnesite, Siderite, Aragonite, Cerussite, Azurite, Malachite.

**Industrial Minerals:** Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varieties, Asbestos.

#### Part C: PALAEOLOGY

Identification and description of general morphological features of the following fossils:

Phylum Mollusca: Pelecepods, Gastropods, Cephalopods.

Phylum Brachiopod.

Phylum Echinodermata: Echinoidea.

Phylum Arthropoda: Trilobites.

Plant fossils: Glossopteris, Ptilophyllum.

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