SYLLABUS

Session-2016-17

P.G. Diploma in Hydrogeology

DEPARTMENT OF GEOLOGY
ALIGARH MUSLIM UNIVERSITY
ALIGARH
**Programme: PG Diploma (Hydrogeology)**
*(Total Two Semesters)*
Department of Geology, Aligarh Muslim University, Aligarh  
Session 2016-17  
Course Structure

<table>
<thead>
<tr>
<th>Type of Course</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Marks Distribution</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sessional</td>
<td>Exam</td>
</tr>
<tr>
<td>Paper-I (a)</td>
<td>DHG151</td>
<td>Mathematics and Statistics (for Geology students)</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Paper-I (b)</td>
<td>DHG152</td>
<td>General Geology (for Engineering students)</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Paper-II</td>
<td>DHG153</td>
<td>Hydrology</td>
<td>30</td>
<td>70</td>
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<tr>
<td>Paper-III</td>
<td>DHG154</td>
<td>Hydrometeorology</td>
<td>15</td>
<td>35</td>
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<tr>
<td>Paper-IV</td>
<td>DHG155</td>
<td>Groundwater Geology and Environmental Impact</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Paper-V</td>
<td>DHG156</td>
<td>Hydrochemistry</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Lab I</td>
<td>DHG1P1</td>
<td>Lab Course for Paper II, III and IV</td>
<td>15</td>
<td>35</td>
</tr>
</tbody>
</table>
| Field Work     | DHG1W1     | Field Training:  
|               |            | a) Report  
b) Viva voce | 15       | 15    | 35    | 100   | 4     |
|                |            |              | Total     |       |       | 210 420 600 24 |

Total
Programme: PG Diploma (Hydrogeology)
(Total Two Semesters)
Department of Geology, Aligarh Muslim University, Aligarh
Session 2016-17
Course Structure

| Second Semester |
|-----------------|-----------------|-----------------|-----------------|
| Type of Course  | Course No.      | Course Title                | Marks Distribution | Credit |
| Paper-I         | DHG251          | Groundwater Modelling       | 30 | 70 | 100 | 4 |
| Paper-II        | DHG252          | Computer Applications       | 30 | 70 | 100 | 4 |
| Paper-III       | DHG253          | Geochemical Survey and Water Quality | 30 | 70 | 100 | 4 |
| Paper-IV        | DHG254          | Groundwater Exploration     | 30 | 70 | 100 | 4 |
| Paper-V         | DHG255          | Well Hydraulics             | 30 | 70 | 100 | 4 |
| Lab I           | DHG2P1          | Lab Course for Paper I,II and III | 15 | 35 | 50 | 2 |
| Lab II          | DHG2P2          | Lab Course for Paper IV and V | 15 | 35 | 50 | 2 |
| Total           |                 |                              | 180 | 420 | 600 | 24 |
P.G. Diploma in Hydrogeology
2016-17
Semester-I

MATHEMATICS AND STATISTICS
Paper- I(a) Max. Marks: 100

Unit-I
Functions: Limits and Continuity of functions.
Derivative of a function and its geometrical meaning: Differentiation from the first principle
(simple cases.)
Formulae for finding derivatives: Sum, Product and Quotient of functions. Applications of
derivatives (motion in st. line and motion under gravity).
Integration of elementary functions: Integration by substitution and by parts. Some properties
of definite integral. Evaluation of definite integrals.

Unit-II
Differential equations: order and degree of d.e . Formation of differential equations (simple
cases) by eliminating arbitrary constants. Solution of differential equations (simple cases).
Properties of determinants. Ad joint and inverse of a matrix. Solution of simultaneous
equations using determinants (Cramer’s Rule).

Unit-III
Definition of statistics, Measures of location (or central tendency) and dispersion,
Measures of skewness and kurtosis, Correlation coefficient, Equations of simple
linear regression. Axiomatic definition of probability, sample space and events,
conditional probability, Independence of events, Addition and multiplication
theorems of probability, Bayes’s theorems.

Unit-IV
Definition of random variable, Discrete and continuous random variables, Probability
mass function, Probability density function, Cumulative distribution function. Some
standard probability distributions (Binominal, Poisson and Normal distributions).
Spatial data and spatial models, Introduction of Geostatistics, Examples of
Geostatistical data, Variogram, Nugget Effect, Anisotropy.

Books Recommended:
1. Mathematics : A text book for class XII (part-I & II )-National Council of Educational
   Research and Training.
2. Introductory to Probability Models – Sheldon M. Ross
   & sons).
   Research and Training.
Unit-I

Unit-II
The nature and importance of rocks, their three classes of mode of formation. Classification of igneous, sedimentary and metamorphic rocks. Forms and structure of extrusive and intrusive igneous rocks. Important primary sedimentary structures. Structures of metamorphic rock-slaty schistose, granulose, cataclastic and mylonitic.

Unit-III
Description and nomenclature of folds, Geometric classification of folds. Unconformities, and their types. Description of faults, classification of faults, Joints and their classification.

Unit-IV
Weathering-types, soil formation. Mass movement-rapid & slow movements. Broad idea about major erosional & depositional landforms created by running water and wind. Introduction to soils, soils structure, soil color, soil texture, soil profile, soil classification, Engineering properties of soils.

Books Recommended:

2. Physical Geology - Arthur Holmes
5. A Text Book of Geology - Mukherjee P.K.
6. Environmental Geology by Edward A. Keller
Unit-I
Introduction: Definition and scope of Hydrology, Practical Applications.
Precipitation: Introduction, forms of precipitation, characteristics of precipitation in India, measurement of precipitation, presentation of rainfall data.
Computation of mean precipitation over an area by Arithmetic mean method, Thiessen polygon method and Isohyetal method.

Unit-II
Evaporation: Evaporation process, factors affecting evaporation, empirical equations and analytical methods of evaporation estimation.
Evapotranspiration: Transpiration, evapotranspiration, measurement of evapotranspiration, Evapotranspiration equations.

Unit-III
Infiltration: Infiltration process, factors affecting infiltration, infiltration capacity, measurement of infiltration, infiltration equations, infiltration indices,
Runoff: Introduction, components of runoff, factors affecting runoff, methods of estimating, annual runoff volume, flow duration curve, flow mass curve.

Unit-IV
Hydrograph Analysis: Introduction components of a hydrograph, base flow separation, effective rainfall,
Unit hydrograph theory, assumption and limitation of unit hydrograph,
Applications of unit hydrograph,
Derivation of unit hydrograph.
Stream Flow Measurement: Introduction, measurement of stage, measurement of velocity; area-velocity method,
Stream flow measurement techniques: dilution technique, electromagnetic method, ultrasonic methods, stage discharge relationship.

Books Recommended:
1. Engineering Hydrology-K. Subramanya
P.G. Diploma in Hydrogeology  
2016-17  
Semester-I  
HYDROMETEOREOLOGY  
Paper- III  
Max. Marks: 100

Unit-I
Hydrometeology, Hydrometeorological elements.  
Atmosphere, Composition of the atmosphere, vertical structure of atmosphere, mass of the atmosphere,  
Heat and temperature changes, the heat budget, radiation process, conduction process and diurnal variations of temperature. Latitudinal heat balance.  
The nature and the laws of electromagnetic radiation, solar radiation, insolation at the earth surface.

Unit-II
Condensation adiabatic rate of cooling condensation nuclei precipitation growth of cloud droplets,  
Precipitation processes, coalescence processes, ice crystal processes.  
Clouds and precipitation: classification and various forms of clouds.  
Airmass nature and classification of airmass.

Unit-III
Fronts, their general characteristics, types of fronts,  
The Wave theory of cyclones, development of cyclones.  
Anticyclones, Thunderstorms,  
Tornales,

Unit-IV
Weather Symbol and weather charts,  
weather analysis and forecasting.  
Role of satellites in weather forecasting.  
weather, instruments used for Meteorological observation.  
Instrument and observations: Thermometer, humidity instrument, wind observations, upper air observation.  
Evaporation measurement; measurements and apparatus, rain gauges, sunshine recorder, pan evapometer.

Books Recommended:

1. Engineering Hydrology-K. Subramanya  
2. Physical Geography-Savindra Singh  
4. Climatology D.S. Lal.
P.G. Diploma in Hydrogeology
2016-17
Semester-I

GROUNDWATER GEOLOGY AND ENVIRONMENTAL IMPACT
Paper- IV

Max. Marks: 100

Unit-I

Unit-II

Unit-III

Unit-IV

Books Recommended:
1. Applied Hydrogeology-C.W. Fetter
3. Groundwater, Freeze & Cherry
P.G. Diploma in Hydrogeology
2016-17
Semester-I

HYDROCHEMISTRY
Paper- V

Max. Marks: 100

Unit-I

Unit-II

Unit-III

Unit-IV

Books Recommended:

1. Chemistry of Water & Microbiology (Mir Publication)- N.F. Voznaya.
3. Applied Hydrogeology-C.W. Fetter
Semester-I

(DHG1P1) Lab Course for Hydrology, Hydrometeorology, Groundwater Geology & Environment Impact
Exercise related to Precipitation and Infiltration and Surface Hydrograph,
Exercise on Darcy’s Law, Permeameter, Grain size analysis
Preparation of Hydrogeological maps: Depth to water table, water table contours, Three-point problem, water table fluctuation maps, Hydrogeological cross sections,
P.G. Diploma in Hydrogeology  
2016-17  
Semester-II

GROUNDWATER MODELLING  
Paper- I

Max. Marks: 100

Unit-I

Unit-II

Unit-III

Unit IV

Books Recommended:
1. C.W. Fetter - Applied Hydrogeology  
2. M. Thangarajan - Regional Groundwater Modeling
P.G. Diploma in Hydrogeology
2016-17
Semester-II

COMPUTER APPLICATIONS
Paper- II
Max. Marks: 100

UNIT- I:

UNIT- II:

Unit III
Introduction to Data Processing : data and information; Data Processing, Data Processing Cycle & Data Processing Operations. Introduction to Database Management System (DBMS): Introduction to database, Database Management System (DBMS), Components of DBMS, Advantages & Disadvantages of using database & DBMS, Data Storage hierarchy: Characters, fields records, files; Primary key, Secondary key, Foreign key. MS- Access: Database Basic concepts, Field, Record, File, Keys: Primary and Secondary Key. Simple Database Creation using 2 or 3 Tables, and Very simple Queries.

Unit IV
Unit I
Groundwater quality monitoring: Planning groundwater monitoring program. Installing groundwater monitoring wells. Withdrawing water samples from monitoring wells. Chemical analysis of natural water. Major ion chemistry. Interpretation of physical and chemical data of water; Methods of illustration pictorial stiff diagram, horizontal and vertical scale diagram. Plotting of piper diagram, Willcox, Gibbs and Durov plots. Outline of global hydrochemical software wateq, PHREEQ, AQUACHEM, MINTEQAZ.

Unit II

Unit III

Unit IV

Books Recommended:
1. Chemistry of Water & Microbiology (Mir Publication)-N.F. Voznaya.
Unit-I

Unit-II
Basic concepts and scope of geophysical exploration for groundwater. Surface geophysical method: Electrical resistivity method-The schlumberger array, the Wenner array, seismic refraction method, Gravity method and magnetic methods.

Unit-III
Sub-surface: Geophysical well logging for delineation of aquifer and estimation of water quality bore hole geophysical logs, their principles and application. Electrical Logging; Resistivity and spontaneous potential logging, Radiation logging; Natural Gamma logging, Gamma-Gamma logging, neutron logging, Calliper logging, Temperature logging, Fluid conductivity logging, Comparison of lithologs in the light of bore hole geophysical data and correlation. Application of well logging in groundwater exploration.

Unit IV

Books Recommended:
1. Photogrammetry-S.N. Pandey.
2. Sabbins, F.F- Remote Sensing-Principles and Applications
3. Lillesand, T.M. and Kieffer, R.W- Remote Sensing and Image Interpretation
4. Pandey, S.N- Principles and Applications of Photogeology
5. Fundamentals of GIS – M. Demers
8. Driss Coll -Ground Water & Well
Unit-I

Unit-II
Evaluation of aquifer parameters using Theis-Non-equilibrium well equation, using type curve and data curve, Jacob’s straight line method, Waltons method, Boulton’s method, water level recovery data analysis (Theis recovery method) distance draw down method.

Unit-III

Unit-IV

Books Recommended:
1. Driss Coll -Ground Water & Well
Semester II
(DHG 2P1) Lab Course for Groundwater modelling, Computer Application, Geochemical Survey
Exercise related to Computer Application
Exercise related to Hydrochemistry and Groundwater Quality
Exercise related to Groundwater Modeling

(DHG 2P2) Lab Course for Groundwater Exploration and Well Hydraulics
Pumping Test Data Analysis: Step Drawdown Test, Constant Discharge Test and Recovery Test Analysis. Flow net Analysis
Exercise related to Groundwater Development and Management, Groundwater Resource Estimation
Remote Sensing: Identification of geomorphological landforms on stereopair, Landuse/Land cover mapping using aerial photograph and satellite images
Exercise on surface geophysical methods