SYLLABUS FOR

POST GRADUATE DIPLOMA IN APPLIED HYDROGEOLOGY

(in collaboration with Rajiv Gandhi National Ground Water Training and Research Institute, CGWB)

Academic Session

2024 – 25

SCHOOL OF STUDIES IN GEOLOGY & WRM

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

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The **AIM** of the Course is capacity building & Research within the state of Chhattisgarh. Applications in Hydrogeology for Geoscientists present the most recent scientific developments in the field that are accessible yet rigorous enough for industry professionals and academic researchers alike.

OBJECTIVE OF THE COURSE is to provide an opportunity for individuals to learn the full scope of hydrogeology. The course addresses the developments in hydrogeology, ground water and hydrology that are underscored with perspectives regarding the challenges that are facing industry professionals, researchers, and academia and emerge as a *Professional Hydrogeologist*.

1. COURSE STRUCTURE AND DURATION

The course shall comprise of two theory papers, two lab course practical and an independent dissertation. The duration of the course will be of one year duration. The details are as follows:

Theory	
Paper I	Groundwater Occurrence, Movement, Distribution & Hydraulics
Paper II	Groundwater Regime Monitoring and Assessment
Practicals	
Lab Course I	Groundwater Occurrence, Movement, Distribution & Hydraulics
Lab Course II	Groundwater Regime Monitoring and Assessment
Dissertation (Report + Presentation + Viva voce)	

2. SCHEME OF EXAMINATION: The total marks for the course shall be 500, including theory, practical and dissertation.

Theory		**Max Marks**
Paper I	Groundwater Occurrence, Movement, Distribution & Hydraulics	100
Paper II	Groundwater Regime Monitoring and Assessment	100
Practicals		
Lab Course I	Groundwater Occurrence, Movement, Distribution & Hydraulics	50

Lab Course II	Groundwater Regime Monitoring and Assessment	50
Dissertation (Report + Presentation + Viva voce)		200
Total		**500**

3. RESULT DECLARATION:

The minimum score for passing theory is 50% and practical is 50%. The candidate has to score minimum 50% marks in theory and practical examination separately. The viva-voce will be based on the overall understanding of the subject

4. SYLLABUS

Paper I: Groundwater Occurrence, Movement, Distribution & Hydraulics
Maximum Marks: 100

Unit – I

Occurrence of Ground Water; Hydrological Cycle; Precipitation, Infiltration, Percolation, Runoff, baseflow; Rainfall data Analysis; Origin, Age, Ground Water on earth; Types of water; Vertical Distribution of Water

Unit – II

Ground Water Movement; Types of Aquifer; Aquifer Properties – Permeability, Storage, Storativity, Transmissivity; Equation Governing groundwater flow, groundwater flow direction, groundwater flow rates, groundwater dispersion

Unit – III

Concept of drainage basin, including watershed and groundwater basin. Aquifer systems and Groundwater Provinces of India; Hydrogeology of Alluvial aquifer, Arid aquifer, Hard rock aquifer/ Basaltic Aquifer, Himalayan aquifer, Coastal and wetland aquifer, Island aquifer.

Unit – IV

Well Hydraulics; Groundwater flow-An Overview; Darcy's law and its applications; Determination of permeability in laboratory and in field; Flow through aquifers; steady, unsteady and radial flow conditions; Effect of partial penetrating wells, well losses, specific capacity; Evaluation of aquifer parameters of confined, semi-confined and unconfined aquifers -Thiem, Thies, Jacob and Walton's methods; Yield characteristics of wells; Pumping tests- methods, data analysis and interpretation.

Unit - V

Role of remote sensing in groundwater exploration; Hydrogeomorphic and lineament mapping; Surface geophysical methods; Types of water wells and methods of construction. Site selection for groundwater exploration, Water well drilling techniques; Design, development, maintenance and revitalization of wells; Sub-surface geophysical methods.

Paper II: Groundwater Regime Monitoring and Assessment

Maximum Marks: 100

Unit – I

Water level monitoring; Water table and piezometric surface, Springs; Fluctuations of water table/Flow net analysis; Barometric and tidal effects; Representation of water level data -Water table contour; Hydrographs; statistics

Unit – II

Ground Water Quality monitoring; Physical and chemical properties of water; Quality criteria and standards for different uses; Groundwater quality in different provinces in India; Groundwater contamination; natural (geogenic) and anthropogenic contaminants; Inland salinity, Saline water intrusion; governing principles, Use of Radioactive isotopes in hydrogeological studies; Collection of water sample and analysis; Presentation of water quality data - contours, point map, statistics

Unit – III

History of Ground Water Assessment in India; Ground Water Estimation Methodology in Vogue i.e. GEC 2015; Ground Water Balance equation; Various inflow terms and their estimation; Various outflow terms including Base flow and their estimation; Estimation of Dynamic and In-storage Ground Water Resources of Unconfined, Confined and Semi-Confined Aquifers. Estimation of Stage of Ground Water Extraction and Categorization; Use of Tracers in Ground Water Studies; Natural and Artificial Tracers and their Application; Various Techniques used in Ground Water Studies to measure the parameters needed in the Assessment of Ground Water Resources.

Unit - IV

Principles of Groundwater Management — supply side and demand side management, Concept of sustainable development of groundwater resources; Groundwater Issues and Challenges -Over-exploitation of groundwater, ground water issues in coastal areas; issues of ground water in mining areas, waterlogging in canal command areas; urban areas; water quality issues; Conjunctive use of surface and groundwater; Impact of Climate change on groundwater resources; Rainwater harvesting and managed aquifer recharge; Rainwater harvesting concept; Rainwater harvesting Methods; Managed aquifer recharge; Site identification, Source water assessment, Recycle and reuse; Recharge Methods; Induced recharge - aquifer – river interaction.

Unit – V

Groundwater modelling; Analytical models, Mathematical models / Numerical models, Statistical / Stochastic models, Time series analysis, Mathematical models -case studies. Groundwater regulation, Groundwater ownership, constitutional provisions, Issues and challenges in groundwater legislation adoption. Groundwater legislation.

Lab Course I: Groundwater Occurrence, Movement, Distribution & Hydraulics
Maximum Marks: 50

Rainfall data analysis, Runoff and baseflow estimation, Demarcation of watershed from drainage map, Determination of permeability in laboratory, Determination of well losses and aquifer losses and well efficiency using step drawdown test data, Determination of T using Theim solution, Determination of T and S values of confined aquifers usingTheis and Jacob solutions, Determination of T and S values of semi-confined aquifers usingWalton solution, Determination of T and S values of unconfined aquifers using Boulton solution, Determination of specific capacity using Slichter method, Determination of optimum yield using Saleem Romani method, Delineation of hydrogeomorphic units and lineaments using visual interpretation techniques, Application of VES for pinpointing a site for water well.

Lab Course 2: Groundwater Regime Monitoring and Assessment
Maximum Marks: 50

Three point problem, Preparation of water table map, Delineation of ground water flow direction, Preparation of water level maps and preparation of fluctuation maps, Preparation of EC contour maps, point maps of fluoride, Piper trilinear diagram, US salinity diagram and Wilcox diagram with chemical parameters. Ground water resources estimation of a watershed using GEC 2015 methodology. Exercise on rainwater harvesting/ artificial recharge – estimation of available resource and selecting suitable methods. Preparation of ground water hydrographs.

Dissertation (Report + Presentation + Viva-voce)
Maximum marks: 200

Dissertation is an essential component of the course. Every student has to carry out fieldwork (in continuation or in breaks) during the course. The candidate will be required to submit a field report for evaluation as a part of the examination. The candidate can choose a theme or a combination of themes, dissertation under the guidance of a Supervisor, as mentioned below:

1. Ground Water Data Collection Feasibility studies
2. Water quality data Collection, analysis and interpretation.
3. Well logs -lithological log, drill time log, geophysical logs
4. Pumping test, Infiltration test, Slug test, Discharge Measurement
5. Geophysical surveys
6. Water audit and Impact assessment
7. Socio-economic surveys – Unit draft, Crops yield and ground water usage, micro irrigation, water use efficiency.

The candidate will have to complete his fieldwork related to Project and the Dissertation thesis must be submitted within 30 days after the completion of theory examination.

Recommended Textbooks: Only the basic textbooks are mentioned here. The student is advised to consult Library and e-resources for in-depth knowledge.

1. C.F. Tolman (1937): Groundwater, McGraw Hill , New York and London.
2. D.K. Todd (1995): Groundwater Hydrology, John Wiley and Sons.
3. F.G. Driscoll (1988): Groundwater and Wells, UOP, Johnson Div.St.Paul. Min. USA.
4. H.M. Raghunath (1990): Groundwater, Wiley Eastern Ltd.
5. H.S. Nagabhushaniah (2001): Groundwater in Hydrosphere (Groundwater hydrology), CBS Publ.
6. K. R. Karanth (1989): Hydrogeology, Tata McGraw Hill Publ.
7. S.N. Davies and R.J.N. De Wiest (1966): Hydrogeology, John Wiley and Sons, New York
8. R. Allan Freeze and John A. Cherry (1979): Groundwater, Prentice-Hall, Inc. ISBN 0-13-365312-9