Post Graduate Diploma in Groundwater Exploration and Watershed Management

Prospectus No. 20131240

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

PROSPECTUS

OF

Post Graduate Diploma in Groundwater Exploration and Watershed Management

2012

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D.K.Joshi
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SANT GADGE BABA AMRAVATI UNIVERSITY

SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

(1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.

(2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/ provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1 : Enrolment of Students.

Ordinance No. 2 : Admission of Students

Ordinance No. 4 : National cadet corps

Ordinance No. 6 : Examinations in General (relevent extracts)

Ordinance No. 18/2001 : An Ordinance to provide grace marks for passing in a Head of passing and Inprovement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001.

Ordinance No. 9 : Conduct of Examinations (relevent extracts)

Ordinance No. 10 : Providing for Exemptions and Compartments

Ordinance No. 19 : Admission of Candidates to Degrees.

Ordinance No. 109 : Recording of a change of name of a University student in the records of the University.

Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

D.K.Joshi
Registrar
Sant Gadge Baba Amravati University.

PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM

The pattern of question paper as per unit system will be boradly based on the following pattern.

(1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.

(2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.

(3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.

(4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60.

(5) Each short answer type question shall Contain 4 to 8 short sub question with no internal choice.

Sant Gadge Baba Amravati University, Amravati
Draft Ordinance No.8 of 2010

Examinations leading to the Post Graduate Diploma in Groundwater Exploration and Watershed Management [Semester Pattern – Two Year (Full Time) P.G.Diploma Course] in the faculty of Science, Ordinance, 2010.

Whereas it is expedient to frame an Ordinance in respect Examinations leading to the Post Graduate Diploma in Groundwater Exploration and Watershed Management [Semester Pattern – Two Year (Full Time) P.G. Diploma Course] in the faculty of Science, Ordinance, 2010 for the purposes hereinafter appearing, the Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be called "Examinations leading to the Post Graduate Diploma in Groundwater Exploration and Watershed Management [Semester Pattern – Two Year (Full Time) P.G.Diploma Course] in the faculty of Science, Ordinance, 2010".

2. This Ordinance shall come into force from the date of its approval by the Management Council.

3. Following shall be the Examinations leading to Post-Graduate Diploma in Groundwater Exploration and Watershed Management-
   (i) Semester-I Examination
   (ii) Semester-II Examination
   (iii) Semester-III Examination, and
   (iv) Semester-IV Examination

4. Duration of each of the above semesters shall be six months with an examination at the end of each semester.

5. (i) The examinations specified in paragraph 3 above shall be held twice a year at such places and on such dates as may be appointed by the Board of Examinations.
   (ii) Main Examinations of Semester-I and Semester-III, shall be held in Winter and Supplementary Examinations in Summer.
   (iii) Main Examinations of Semester-II and Semester-IV, shall be held in Summer and Supplementary Examinations in Winter.

6. Subject to his/her compliance with the provisions of this Ordinance and of any other Ordinances in force from time to time, an applicant for admission to examination shall have obtaned a Bachelor's Degree in Science/Agriculture/Engineering faculty of this University or any other Statutory University whose Degree is recognized as equivalent thereto by S.G.B. Amravati University.

7. For purposes of instructions and examinations, the student shall study sequentially.

8. Subject to his/her compliance with the provisions of this Ordinance and of other Ordinances (Pertaining to Examination in General) in force from time to time, the applicant for admission, at the end of the course of study of a particular Semester shall be eligible to appear at it, if:
   (i) He/She satisfies the conditions in the Table and the Provision there under.
   (ii) He/She prosecutes a regular course of study in University Department/College affiliated to the University.
   (iii) He/She shows satisfactory progress in his/her studies.

Table

Sr. No.	Name of Examination	The student should have completed the following term satisfactorily	The student should have passed following exam.
1.	Diploma in Groundwater Exploration and Watershed Management, Semester-I	The qualifying Semester-I in para 6.	examination
2.	Diploma in Groundwater Exploration and Watershed Management, Semester-II	Semester-II	----
3.	Diploma in Groundwater Exploration and Watershed Management, Semester-III	Semester-III	Semester-I
4.	Diploma in Groundwater Exploration and Watershed Management, Semester-IV	Semester-IV	Semester-I

(Note - Subjects prescribed and numbered in the scheme of examinations shall be treated as seprate subjects, however, theory and practical, if any, of the subject shall be treated as separate head of passing.)

* As approved by Management council, dt. 12/5/2010, vide item No. 186.

9. The Scheme of Teaching and Examinations shall be as appended herewith as Appendix-A.

10. Examination fees shall be as prescribed by the University from time to time.

11. Examinees who are successful at the Semester-I, II, III and IV examinations under this Ordinance and who have obtained 75% or more marks in the aggregate of Semester-I, II, III and IV Examinations shall be placed in the First Division with Distinction, those obtaining 60% or more but less than 75% shall be placed in the First Division, those securing less than 60% but not less than 45% in the second division, and all other successful examinees shall be placed in the third Division.

12. (i) Scope of the subjects shall be as indicated in the syllabus.
(ii) Medium of instruction and examination shall be English.

13. Provision of Ordinance No. 18 of 2001 relating to an Ordinance to provide grace marks for passing in a head of passing and improvement of division (Higher Class) and getting distinction in the subject and condonation of deficiency of marks in a subject in all the faculties prescribed by the Statute No. 18, Ordinance, 2001 and of Ordinance No.10 relating to Providing for Exemptions and Compartments shall apply to the examination under this Ordinance.

14. An examinee who fails or remains absent for the examination shall be eligible for readmission to the same examination on payment of fees as may be prescribed.

15. As soon as possible after the examination, the Board of Examinations shall publish a result of the examinees. The result of the examinations shall be classified as above and merit list shall be notified as per Ordinance No.6.

16. Notwithstanding anything to the contrary in this Ordinance no one shall be admitted to an examination under this Ordinance, if he /she has already passed the same examination or an equivalent examination of any Statutory University.

17. Examinees who have passed in all the subject prescribed for Semester-I, II, III and IV of the examinations of the Diploma course shall be eligible for award of the Post-Graduate Diploma in Groundwater Exploration and Watershed Management (Semester Pattern — Two Year P.G. Diploma course).

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APPENDIX-A

POSTGRADUATE DIPLOMA IN GROUNDWATER EXPLORATION AND WATERSHED MANAGEMENT **T- THEORY**

(TWO YEAR POSTGRADUATE DIPLOMA COURSE) SEMESTER PATTERN **P-PRACTICAL**

Sr. No	Paper/ Practical	Subject/Code	Teaching Scheme			*Examination Scheme*									
			T	P	Total Periods per week	Theory					Practical				Total
						Duration of papers (Hrs)	Maxim Marks theory papers	Max. Marks college Assessment	Total	Min. Pass Marks	Max. Marks	Max Marks College Assessment	Total	Min. Pass Marks	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Semester-I													
1	Paper-I	FUNDAMENTALS OF GEOLOGY /1GWM-1	5	--	5	3	80	20	100	40	--	--	--	--	100
2	Paper-II	FUNDAMENTALS OF WATERSHED /1GWM-2	5	--	5	3	80	20	100	40	--	--	--	--	100
3	Paper-III	FUNDAMENTALS OF HYDROLOGY /1GWM-3	5	--	5	3	80	20	100	40	--	--	--	--	100
4	Paper-IV	FUNDAMENTALS OF GROUND WATER /1GWM-4	5	--	5	3	80	20	100	40	--	--	--	--	100
5	Practical-I	GEOLOGY AND WATERSHED /1GWM-5	--	3	3	--	--	--	--	--	25	25	50	25	50
6	Practical-II	HYDROLOGY AND GROUNDWATER /1GWM-6	--	3	3	--	--	--	--	--	25	25	50	25	50
		Total	20	6	26				400				100		500
		Semester-II													
1	Paper-V	**WATER WELL TECHNOLOGY /2GWM-1**	5	--	5	3	80	20	100	40	--	--	--		100
2	Paper-VI	**HYDROCHEMISTRY /2GWM-2**	5	--	5	3	80	20	100	40	--	--	--		100
3	Paper-VII	**GEOPHYSICAL EXPLORATION /2GWM-3**	5	--	5	3	80	20	100	40	--	--	--		100
4	Paper-VIII	WATERSHED MANAGEMENT /2GWM-4	5	--	5	3	80	20	100	40	--	--	--		100
5	Practical-III	HYDROCHEMISTRY AND WATER WELL TECHNOLOGY /2GWM-5	--	3	3	--	--	--	--	--	25	25	50	25	50
6	Practical-IV	**WATERSHED MANAGEMENT AND GEOPHYSICAL EXPLORATION /2GWM-6**	--	3	3	--	--	--	--	--	25	25	50	25	50
		Total	20	6	26				400				100		500
		Semester-III													
1	Paper-IX	WATER MANAGEMENT /3GWM-1	5	--	5	3	80	20	100	40	--	--	--	--	100
2	Paper-X	IRRIGATION WATER MANAGEMENT /3GWM-2	5	--	5	3	80	20	100	40	--	--	--	--	100
3	Paper-XI	**REMOTE SENSING /3GWM-3**	5	--	5	3	80	20	100	40	--	--	--	--	100
4	Paper-XII	**REMOTE SENSING APPLICATIONS/3GWM-4**	5	--	5	3	80	20	100	40	--	--	--	--	100
5	Practical-V	IRRIGATION WATER MANAGEMENT /3GWM-5	--	3	3	--	--	--	--	--	25	25	50	25	50
6	Practical-VI	REMOTE SENSING /3GWM-6	--	3	3	--	--	--	--	--	25	25	50	25	50
		Total	20	6	26				400				100		500
		Semester-IV													
1	Paper-XIII	**DIGITAL IMAGE PROCESSING /4GWM-1**	5	--	5	3	80	20	100	40	--	--	--		100
2	Paper-XIV	GIS- FUNDAMENTALS AND APPLICATIONS/4GWM-2	5	--	5	3	80	20	100	40	--	--	--		100
3	Paper-XV	**INTEGRATED WATERSHED MANAGEMENT AND SUSTAINABLE DEVELOPMENT/4GWM-3**	5	--	5	3	80	20	100	40	--	--	--		100
4	Pract.-VII	GIS AND DIGITAL IMAGE PROCESSING /4GWM-4	--	3	3	--	--	--	--	--	25	25	50	25	50
5	Pract.-VIII	PROJECT /4GWM-5	--	6	6	--	--	--	--	--	75	75*	150	75	150
		Total	15	9	24				300				200		500

Project College Assessment:- 75* = 50 (Project) + 25 (Seminar)

Note: Whenever the scheme / course content is updated the failures candidates shall have to appear in the examination as per the current scheme in force.

Sang Gadge Baba Amravati University, Amravati
DIRECTION

No. : 17 / 2012 Date : 20/4/2012

Subject : Examinations leading to the Post Graduate Diploma in Ground Water Exploration and Watershed Management, Direction, 2012.

Whereas, Ordinance No.8 of 2010 in respect of Examinations leading to the Post Graduate Diploma in Ground Water Exploration and Watershed Management, is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 13.1.2012 vide item No.14 (5) D) R-3 has resolved to accept the revised syllabi of P.G. Diploma in Ground Water Exploration and Watershed Management, Semester-I to IV to be implemented from the Academic Session 2012-13 and onwards.

AND

Whereas, the Academic Council further resolved to refer the matter regarding changes in the title of the paper in the scheme of examination to Ordinance Committee for amending the Ordinance.

AND

Whereas, making amendments in Original Ordinance No.8 of 2010 is likely to take some time.

AND

Whereas, the syllabi for the session 2012-13 has to be sent for printing and the admission to student for P.G. Diploma in Ground Water Exploration and Watershed Management course are to be made in the Academic Session 2012-13.

Now, therefore, I, Dr.Mohan K.Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called "Examinations leading to the Post Graduate Diploma in Ground Water Exploration and Watershed Management, Direction, 2012".
2. This direction shall come into force from the date of its issuance.
3. The Appendix-'A' appended to Ordinance relating to Examinations leading to the Post Graduate Diploma in Ground Water Exploration and Watershed Management i.e. Original Ordinnce No.8 of 2010 shall be substituted by the revised scheme of examinations as per 'Appendix-A' appended to this Direction.

Sd/-

Amravati (Dr.Mohan K.Khedkar)
Date : 19/4/2012 Vice-Chancellor

Sant Gadge Baba Amravati University, Amravati,
SYLLABUS FOR
"P. G. DIPLOMA IN GROUNDWATER EXPLORATION AND WATERSHED MANAGEMENT"
(With Effect from June 2012)

Semester I

Paper-I	FUNDAMENTALS OF GEOLOGY (1GWM-1)
Paper-II	FUNDAMENTALS OF WATERSHED (1GWM-2)
Paper-III	FUNDAMENTALS OF HYDROLOGY (1GWM-3)
Paper-IV	FUNDAMENTALS OF GROUNDWATER (1GWM-4)
Practical-I	GEOLOGY AND WATERSHED (1GWM-5)
Practical-II	HYDROLOGY AND GROUNDWATER (1GWM-6)

Semester II

Paper-V	WATER WELL TECHNOLOGY (2GWM-1)
Paper-VI	HYDROCHEMISTRY (2GWM-2)
Paper-VII	GEOPHYSICAL EXPLORATION (2GWM-3)
Paper-VIII	WATERSHED MANAGEMENT (2GWM-4)
Practical-III	HYDROCHEMISTRY AND WATER WELL TECHNOLOGY (2GWM-5)
Practical-IV	WATERSHED MANAGEMENT AND GEOPHYSICAL EXPLORATION (2GWM-6)

Semester III

Paper-IX	WATER MANAGEMENT (3GWM-1)
Paper-X	IRRIGATION WATER MANAGEMENT (3GWM-2)
Paper-XI	REMOTE SENSING (3GWM-3)
Paper-XII	REMOTE SENSING APPLICATIONS (3GWM-4)
Practical-V	IRRIGATION WATER MANAGEMENT (3GWM-5)
Practical-VI	REMOTE SENSING (3GWM-6)

Semester IV

Paper-XIII	DIGITAL IMAGE PROCESSING (4GWM-1)
Paper-XIV	GIS- FUNDAMENTALS AND APPLICATIONS (4GWM-2)
Paper-XV	INTEGRATED WATERSHED MANAGEMENT AND SUSTAINABLE DEVELOPMENT (4GWM-3)
PracticalVII	GIS AND DIGITAL IMAGE PROCESSING (4GWM-4)
Practical VIII	PROJECT (4GWM-5)

(Note: The Scheme of Examination will be as per earlier pattern)

SYLLABUS PRESCRIBED FOR P. G. DIPLOMA IN GROUNDWATER EXPLORATION AND WATERSHED MANAGEMENT

SEMESTER-I
PAPER-I
FUNDAMENTALS OF GEOLOGY (1GWM-1)

(10 Lect. / Unit)

Unit-I : Introductory Geology: Rock as an aggregate of minerals, Igneous, Sedimentary and Metamorphic rocks. Structure and textures and classification of these rocks. Distribution of geological formations of India and its importance in relation to water bearing characteristics.

Unit-II : Weathering, mechanical weathering, Chemical weathering, factors affecting weathering, Weathering of Granite and Basalt, Soils, Soil formation, factors affecting soil formation, Soil profile and constituents of soil.

Unit-III : Physical properties of soils- texture, structure, mineral nutrients of plants, role of essential nutrients, soil fertility and its evaluation, types of soils in India. Soil erosion-factors affecting erosion, Types of soil erosion-universal loss equation.

Unit-IV : Rock as layers (beds), their attitude. Use of clinometer and Brunton compass. Simple geologic structures like folds, faults, joints and unconformities – their nomenclature, classification and recognition. Importance of these structures in groundwater exploration and management.

Unit-V : Geomorphology- geomorphic processes, endogenic and exogenic. Geological work of wind, river, glaciers, underground water –erosion, transportation and deposition.

Books:-

1. Ravindra Kumar, Fundamentals of Historical Geology.
2. Billing M.P Structural Geology.
3. Savindra Singh, Geomorphology.
4. Marshak and Mitra , Basic Methods in Structural Geology, Printicee Hall.
5. Parbin Singh, Text Book of Engineering Geology.
6. Mukerjee P.K Text Book of Geology.
7. Potter and Skinner, Dynamic Earth.
8. Patwardhan , The Dynamic Earth System, Printce Hall Inc.

Paper-II
FUNDAMENTALS OF WATERSHED (1GWM-2)

(10 Lect. / Unit)

Unit-I : Earth System: Atmosphere, hydrosphere and lithosphere. Weather and climate, atmospheric general circulation. Air mass as weather fronts, weather elements. Monsoon circulation, types of rainfall distribution.

Unit-II : Morphometric and hypsometric analysis of drainage basin-Linear, Aerial and Relief Aspects, Drainage Patterns and their significance in hydrogeological studies.

Unit-III : Hydrologic Cycle- precipitation, evaporation and transpiration, infilteration, runoff. Relation to soil characterstics, relation to groundwater, estimation of water balance and its components.

Unit-IV : Watersheds Concept, Principles and Objectives, Watersheds characteristics, causes of deterioration. Principle factors influencing watershed operation. Management - Integrated Multi-disciplinary approach, Master plan and Administrative aspects.

Unit-V : Land-Survey, preparation and development, Soil moisture conservation, Conservation measures, Rainwater management, reclamation of saline soils.
Water-Surface water-Rainwater harvesting, groundwater, well construction, integrated water resource management, conjunctive use and perennial yield.

Books:

1. Karanth K.R, Groundwater Assessment Development andManagement.
2. Tidewan E.M Watershed Management- Guidelines for Indian Conditions.
3. Murthy J.V.S Water Management in India.

Paper-III
FUNDAMENTALS OF HYDROLOGY (1GWM-3)

Unit-I : Precipitation-Forms and Characteristics of Precipitation, Measurement of Precipitation, mean precipitation over an area. Evaporation- process, empirical evaporation equations, analytical methods of evaporation estimation. Transpiration, evapotranspiration, measurement of evapotranspiration, Infilteration- infilteration capacity,

measurement of infilteration, classification of infilteration capacity, infilteration indices.

Unit-II : Measurement and runoff - measurement of velocity, area velocity method, dilution techniques, electromagnetic method, ultrasound method, indirect methods, stage-discharge relationship, exploration of rating curves. Runoff characteristics of streams, runoff volume, flow-duration curve, flow mass curve, droughts.

Unit-III : Hydrographs, Factors affecting Hydrograph, Components of hydrograph, Base flow separation, Effective rainfall, Unit Hydrograph, Derivation of unit hydrograph, Unit Hydrograph of different durations, Use and limitations of unit hydrograph.

Unit-IV : Floods-Rational method, Empirical formulae, Unit hydrograph method, Flood frequency studies, Gumbel's method, Log-Pearson distribution, partial duration series, regional flood frequency analysis, data for frequency studies, design floods. Flood Routing-Basic equations, hydrologic storage routing, attenuation, hydrologic channel routing, hydraulic method of flood routing, Flood control.

Unit-V : Erosion and Reservoir Sedimentation-Erosion Processes, Estimation of sheet Erosion, Channel Erosion, Movement of sediments from watersheds, Sediment yield from watersheds, Trap Efficiency, Density of sediments deposits, Distribution of Sediments in the Reservoir, Life of a reservoir, Reservoir Sedimentation Control.

Text Books-

1. Engineering Hydrology- K Subramanya 3ed. The McGraw-Hill Company.

Paper-IV
FUNDAMENTALS OF GROUNDWATER (1GWM-4)

(10 Lect. / Unit)

Unit-I : Groundwater occurrence- vertical distribution of groundwater. Hydrologic properties and groundwater flow-grain size distribution, porosity, specific yield, specific retention, relation to texture, storage coefficient.

Unit-II : Groundwater flow- Movement of groundwater, Darcy's law and its validity, three dimensional flow, permeability, conductivity, anisotropy and heterogeneity, formation constants, transmissibility, leakage factor.

Unit-III : Aquifers, types of aquifers- unconfined, confined, semi confined and leaky aquifers. Water level measurement-unconfined and confined aquifer. Water level hydrographs.

Unit-IV : Evaluation and interpretation of groundwater data-groundwater maps- water table maps, depth to water table map, groundwater fluctuation map, hydraulic head difference map, groundwater quality map. Causes of fluctuation of groundwater levels.

Unit-V : Evaluation of groundwater contour map - flow direction, hydraulic gradient, groundwater structure, influent and affluent seepage, use of flow nets. Evaluation of water table fluctuation, hydraulic difference and groundwater quality maps.

Books:-

1. Karanth K.R, Groundwater Assessment Development and Management.
2. Ragunath, Hydrology
3. Todd D.K , Groundwater Hydrology.
4. Mahajan, Groundwater Evaluation
5. Davis and Dewest :Geohydrology.
6. Fetter C.W, Applied Hydrology.
7. Gautam Mhajan, Groundwater Surveys and Investigations.
8. RamKrishna S, Groundwater.
9. Schwartz, Fundamentals of Groundwater, J. Wileys
10. Domenico, Physical and Chemical Hydrogeology, Wileys

PRACTICALS :

PRACTICAL- I
GEOLOGY AND WATERSHED (1GWM-5)

1. Study of common igneous, sedimentary and metamorphic rocks. Study of types of soils. Calculation of weathering indices in soils and sediments.
2. Topographic maps. Orientation of maps, map reading, locating of position on the map. Use of clinometer compass, brunton compass for location on the map.
3. Field study of drainage pattern and delination of watershed. Analysis of drainage basins.
4. Drawing of block diagrams of folds, faults, joints and unconformities and their significance in groundwater studies.
5. Field visit for identification of different rock types, study different geomorphic features like river deposits, terraces, gullies, soil erosion and other features including drainage patterns.

PRACTICAL-II

HYDROLOGY AND GROUNDWATER (1GWM-6)

1. Determination of mean aerial depth of rainfall by Theissen polygons and by Isoheytal methods.
2. Estimation of stream velocity and run-off.
3. Analysis of hydrographs and estimation of infilteration capacity.
4. Preparation and interpretation of water table maps.
5. Delination of hydrological boundaries on water-table contour maps and estimation of permeability.
6. Numerical problems based on theory related to paper Water Management and Irrigation water management.

SYLLABUS PRESCRIBED FOR POST GRADUATE DIPLOMA IN GROUNDWATER EXPLORATION AND WATERSHED MANAGEMENT

SEMESTER-II

Paper-V

WATER WELL TECHNOLOGY (2GWM-1)

(10 Lect. / Unit)

Unit-I : Geomorphic and geologic control of groundwater. Introduction to Geologic, hydrologic and geohydrological methods of groundwater exploration. Groundwater provenances of India. .

Unit-II : Water well Designs- well diameter, well depths, design of well screen, open well vs bore well, tube well, design of tube well. Economic viability.

Unit-III : Water well Drilling- Boring, driving, cavity wells, jetting, core drilling, rotary drilling, DTH drilling, well revitalization, blasting techniques.

Unit-IV : Water well Construction- Types, Construction and design of wells. Installation of well screens, fishing operation, well development, well completion.

Unit-V : Yield test and Selection of Pump Sets- testing for yield, discharge measurements, method of measuring water levels, slug test, selection of pump sets, jet pumps, submerscible pumps, centrifugal pumps.

Books:-

1. Garg, Groundwater and Tube Wells.
2. Groundwatrer Manual-USDA.

3. Walton, Groundwater Resource Evaluation.
4. Gard, S.P. Groundwater and Tube wells. Oxford and IBH.
5. Karanth K.R, Groundwater Assessment Development and Management.
6. Johnson E.E Groundwater and Wells.

PAPER-VI

HYDROCHEMISTRY (2GWM-2)

(10 Lect. / Unit)

Unit-I : Physical, chemical and bacteriological quality. Dissolved constituents in groundwater (major, minor and trace elements). Changes in the chemical composition.

Unit-II : Diagrammatic representation of geochemical data- Collins disgram, Vector diagram, Stiff diagram, Pie diagram, Isogram maps. Trilinear plots- Palmer, Emmons, Hill, Piper diagrams.

Unit-III : Interpretation of chemical Data- Ionic formula, Ionic ratios, Trilinear Plots, Piper, Logrithmic diagram-Schoeller, Mixing diagrams, Natural classification of water.

Unit-IV : Chemical processes occurring in groundwater-Dissolution and precipitation, Adsorption and Ion Exchange, Mixing, Oxidation, Reduction, membrane effects.

Unit-V : Quality criteria for groundwater supplies- Drinking and Domestic, Irrigation, and Industrial use. Pollution and water quality monitoring- pollution of surface and groundwater and its health hazards, preventive measures.

Books :

1. Standard methods for examination of water and waste water analysis-APHA-AWWA-WEF.
2. Hem J.D, Study and Interpretation of Chemical Characterstics of Groundwater.
3. Karanth K.R, Groundwater Assessment Development and Management.
4. Raymahashay , Geochemistry for Hydrogeologist , Allied Pub.
5. Freeze and Cherry J.A , Groundwater, Oxford and IBH
6. Domenico, Physical and Chemical Hydrogeology, Wileys

PAPER-VII
GEOPHYSICAL EXPLORATION (2GWM-3)

(10 Lect. / Unit)

Unit-I : Surface geophysical methods. Electrical Methods: Resistivity Methods, Instruments, Field procedures, Data collection, Interpretation and Applications. Self-Potential Method.

Unit-II : Seismic Methods-Reflection method and Refraction Methods- Principle, Instruments and equipments, Field operational methods, data collection, Interpretation and Applications.

Unit-III : Magnetic Methods: Principles, Instruments, field procedures, data collection, Interpretation and Applications.

Unit-IV : Gravity Methods: Principles, Instruments, Field procedures, data collection, Interpretation and Applications.

Unit-V : Well Logging Methods: Electrical logging methods- Self Potential logging, Resistivity logging and other miscellaneous logging methods; Interpretations and Application of well logging methods.

Books:-

1. Ramchandra Rao, Outline of Geophysical Exploration.
2. Brooks K, Geophysical Exploration.
3. Dobrin M.B, Geophysical Exploration.
4. Bhattachraya and Patra, Direct Current Geoelectric Sounding-Principles and application. Allied /Elsiever
5. Agrogysawamy , Geotechnical methods in Exploration and exploitation of groundwater. Allied pub.
6. Nath S.K , Geophysical Prospecting for Groundwater Oxford and IBH,

PAPER-VIII
WATERSHED MANAGEMENT (2GWM-4)

(10 Lect. / Unit)

Unit-I : Phases in groundwater development. Delineation of groundwater system- fixed boundaries, movable boundaries, arbitrary boundaries, replenishment areas, discharge areas, exploitation areas/ groundwater basin.

Unit-II : Watershed delineation, codification, macro and micro level delineation, drainage basins, project formulation on watershed, analysis of project elements, assistances need and economic survey.

Unit-III : Objectives of planning watershed projects, guidelines for project preparation. Watershed resources management with multiple use. Project implementation and management. Watershed impact analysis.

Unit-IV : Soil and water conservation practices. Water Conservation measures, gully control, terracing, building check dams, reclamation of soils. Water harvesting- rainwater harvesting and roof water harvesting.

Unit-V : Artificial recharge methods including aquifer storage recovery. Geotechnical investigation and design of artificial recharge structures. Evaluating the efficiencies of artificial recharge structures. Management of artificial recharge aquifers.

Books:-

1. Tideman, E.M Watershed Management guidelines for Indian conditions. Omega Scientific Publications, New Delhi.
2. Murthy, J.V.S. Water management in India. Wiley Estern.
3. Clorer R.C, Groundwater Management.
4. Karanth K.R, Groundwater Assessment Development andManagement.
5. Ganesh A , Water Resource Evaluation Methods and Techniques, Satish Serial Pub.

PRACTICALS :

PRACTICAL-III
HYDROCHEMISTRY AND WATER WELL TECHNOLOGY (2GWM-5)

1. Determining quality of water by using water analysis kit and other instrumental, volumetric, gravimetric methods.
2. Plotting of chemical analytical data and its interpretation.
3. Soil sampling and analysis.
4. Pumping test: time-drawdown and time recovery tests. Computation of aquifer characteristics from pumping test data and evaluation of aquifer parameters. Step draw down tests and recovery method.

5. Identification of sites for soil and water conservation structures such as gully plugging, contour trenching, check dams, cost estimation and design.
6. Visit to well drilling site and artificial recharge structures.

PRACTICAL-IV
WATERSHED MANAGEMENT AND GEOPHYSICAL EXPLORATION (2GWM-6)

1. Field procedures in Electrical resistivity survey. Collection of field data, Plotting and Interpretation of Electrical Resistivity data by curve matching, inverse slope method and computer aides system.
2. Field procedures in seismic refraction technique, Collection of field data, Plotting and Interpretation of seismic refraction data and its interpretation.
3. Study of geophysical well logs. Interpretation of Resistivity and SP logs.
4. Location of groundwater provinces in the outline map of India.

SYLLABUS FOR P.G. DIPLOMA IN GROUNDWATER EXPLORATION AND WATERSHED MANAGEMENT

SEMESTER-III
Paper-IX
WATER MANAGEMENT (3GWM-1)

(10 Lect. / Unit)

Unit-I : Irrigation water Management- Crop requirements and irrigation scheduling. Crop selection, depth and frequency application of water irrigation schedules. Water use efficiency and cropping patterns.

Unit-II : Water conveyance and application methods. Drip and sprinkler irrigation systems. Drainage - causes of water logging, design of surface and subsurface drains, saline and alkaline lands. Reclamation and management of salt affected lands.

Unit-III : Quality of Water and Irrigation-Quality of Irrigation water, Changes in water quality, water quality as influenced by potassium and nitrate, changes in soil properties through irrigation water, irrigation with saline water, growing crops in salt affected areas, improving quality of saline water.

Unit-IV : Factors affecting cropping patterns, evolving cropping pattern, synergism of irrigation and fertilizer, water and

nutrient availability in soils, irrigation and fertilizer interaction on crop growth and yield, quality of crops as influenced by irrigation and nutrient use.

Unit-V : Causes of water logging, signs of bad drainage, classification of drainage, effects of water logging and excess soil water on crops and soils, prevention of high water table and water logging, methods of drainage, drainage need of crop.

Books:-

1. Irrigation water Management-Principles and Practice- D.K Majumdar- Pub. Prentice Hall of India Pvt. Ltd. New Delhi.
2. Karanth K.R, Groundwater Assessment Development andManagement.
3. Tidewan E.M ,Watershed Management- Guidelines for Indian Conditions.

PAPER-IX
IRRIGATION WATER MANAGEMENT (3GWM-2)

(10 Lect. / Unit)

Unit-I : Sources of water for crops, Classification of Soil Water, Soil water constants, Energy concept of soil water, forces acting on soil water, Soil water potential concepts, Soil water retention.

Unit-II : Soil water-Plant relationship- Role of water in plants, Water absorption by plants, water conduction, Transpiration, soil water availability and water in soil plant atmosphere system, water and plant processes, soil water availability to plants.

Unit-III : Estimating water requirement of crops- evapotranspiration and consumptive use, methods of estimating evapotranspiration, effective rainfall, percolation loss, irrigation requirement, water table and irrigation requirement.

Unit-IV : Methods of Irrigation-Classification of Irrigation methods, Surface irrigation methods, Subsurface irrigation methods, Overhead or Sprinkler Irrigation method, Drip Irrigation method, New Irrigation methods, Methods of Water Measurements.

Unit-V : Irrigation Efficiency and Irrigation Scheduling-Project Irrigation Efficiency and its components, Efficiencies of Irrigation practices. Time of Irrigation, Critical Stages of Water need of crops, Criteria for Scheduling Irrigation, Frequency and Interval of Irrigation, Depth of Irrigation.

Books-

1. D.K Majumdar, Irrigation water Management-Principles and Practice- Prentice Hall of India Pvt. Ltd. New Delhi.

PAPER-XI
REMOTE SENSING (3GWM-3)

(10 Lect. / Unit)

Unit-I : Aerial photography- Defination and terminology. Geometry and types of aerial photographs. Photographic scale. Relief displacement, photographic masaics. Visual image interpretation, key elements, topography, drainage patterns and texture, erosion, image tone, vegetation and land use.

Unit-II : Physics of remote sensing- Electromagnetic spectrum, Interaction of earth surface features with EMR,

Unit-III : Interaction with Microwave with earth surface, Remote Sensing Observation platforms, Characteristics of remote sensors, microwave sensors, false colour composite.

Unit-IV : Multispectral sensors- multispectral remote sensing, multiband cameras, opto-mechanic scanners, modular multispectral scanners, landsat multispectral scanners, thematic mapper, linear imaging self-scanning sensors.

Unit-V : Microwave remote sensing- microwave radiometer, sidelooking airborne radar, syntheticaperture radar, wind scatterometer, radar polarimetry, radar interferometry.

Books:-

1. Drury, Image Interpretation in Geology.
2. Pandey P.C, Principles of Photogeology.
3. Lillistand and Keifer, Principles of Remote Sensing and Image interpretation..
4. Sabins, Remote Sensing Principles and Interpretations.
5. B.C Panda , Remote Sensing-Principles and Application, Viva Publ.
6. Chandra and Ghosh , Remote sensing and GIS, Narosa Pub.

PAPER-XII
REMOTE SENSING APPLICATIONS (3GWM-4)

(10 Lect. / Unit)

Unit-I : Fundamentals of Geological-Image Interpretation-Image elements- tone / colour, texture, pattern, shape, size, shadows, sites, associations. Terrain elements- drainage patterns, drainage density, landforms, erosion.

Unit-II : Remote sensing for lithological discrimination and geological mapping.spectral signatures of rocks, interpretation processes, significance of drainage analysis, criteria for lithological discrimination, criteria for structural mapping.

Unit-III : Application of thermal remote sensing in geology- basic concepts, thermal properties of material, atmospheric windows for thermal infrared remote sensing, interpretation of thermal infrared data.

Unit-IV : Remote sensing application for land use / land cover mapping, methodology, phases in interpretation. Spectral behavior of soils, Soil categorization, mapping of degraded land, erosion assessment, crop acreages estimation.

Unit-V : Remote sensing in groundwater studies- groundwater prospect mapping, groundwater resource estimation and budgeting, groundwater draft estimation, groundwater balance studies and augmentation of groundwater resource.

Books:-

1. Drury, Image Interpretation in Geology..
2. Lillistand and Keifer, Principles of Remote Sensing and Image interpretation..
3. Sabins, Remote Sensing Principles and Interpretations.

PRACTICALS

PRACTICAL-V
IRRIGATION WATER MANAGEMENT (3GWM-5)

1. Estimation of water requirement of crops.
2. Measurement of water flow-orifice meter, notches etc.
3. Estimating the irrigation efficiency of project.
4. Numerical problems based on theory related to paper Water Management and Irrigation water management.

PAPER-VI
REMOTE SENSING (3GWM-6)

1. Stero test. Orientation of Stereo model under Stereoscope. Determination of Photo Scale. Use of parallax bar. Determination of

Heights. Preparation of Photo Index. Identification of features on vertical aerial photograph.

2. Study of Satellite imagery, Border information, and Reference System. Study of Satellite imagery in different bands by visual interpretation. Study and interpretation of satellite imageries and preparation of theme based maps. Pre-field interpretation and Field Checks.

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SEMESTER-IV
PAPER-XIII
DIGITAL IMAGE PROCESSING (4GWM-1)
(10 Lect. / Unit)

Unit-I : Introduction to digital image processing, characteristics of digital images, pixel parameters.

Unit-II : Image processing techniques applied to satellite imagery- image reduction, image magnification, image enhancement, contrast enhancement, ratioing, principal component analysis.

Unit-III : Filtering techniques- discrete linear operations, spatial smoothing operators, spatial sharpening operators, edge detection.

Unit-IV : Classification / pattern recognition., supervised classification, training site selection and extraction of statistics, classification algorithms.

Unit-V : Digital image processing systems- Configuration of digital analysis system: Hardware and Software- Image processing system characteristics.

Books:-

1. NRSA Course Manual, Digital Image Processing.

PAPER-XIV
GIS- FUNDAMENTALS AND APPLICATIONS (4GWM-2)

(10 Lect. / Unit)

Unit-I : Components of GIS- computer hardware and software.

Unit-II : GIS technology and application. Geographical data- point, lines and areas. Database structure-flat file, hierarchical data structure, relational data base structure,

Unit-III : Spatial relationships, Map overlays, Raster and Vector data. Data input and editing. Data query and analysis.

Unit-IV : Spatial data analysis- integrated data analysis of spatial and attribute data, data retrieval, reclassification operations, overlay operations, regional transformation, neighborhood operation, connectivity operations, and spatial auto correlation.

Unit-V : Network analysis and applications. Analytical modeling in GIS.

Books:-

1. Aronoff, S. Geographic Information Systems.

2. Chang kT, Introduction to Geographic Information Systems.

3. Clarke, K.C. Getting started with Geographic Information System. Prentice Hall.

4. Anji Reddy M Geoinformatics for Environmental Application. B.S. Publication. Hyderabad.

5. Demers , Fundamentals of Geographic Information System, J. Wileys

6. Lo and Yeung , Concepts and techniques of Geographic Information System, Printce Hall Inc.

PAPER-XV
INTEGRATED WATERSHED MANAGEMENT AND SUSTAINABLE DEVELOPMENT (4GWM-3)

(10 Lect. / Unit)

Unit-I : Integrated Watershed Management- Concept of Watershed, Watershed Characterstics, Causes of watershed deterioration, Principles of Watershed Management, Components of Watershed treatment plan, Steps in implementation of integrated watershed development plans.

Unit-II : Peoples Participation in Watershed Management, Conceptual framework, Concept of people's participation, Typology of participation, Ingredients of peoples participation, Growth of Voluntary and Non Government organization.

Unit-III : Watershed informatics, data bases and regulations. NGO's and their role in water management practices. Sociology and community participation. Social Sustainability, Ingredients of Social Sustainability. Role of women in watershed management, empowerment of women and other gender issues.

Unit-IV : Formation and registration of NGO / Public trust. Rules and regulations. Liaison with government department and donar agencies. Formation of village watershed and water users groups. Functioning of Zilla parishad, thesil (BDO) and gramsabha.

Unit-V : People's participation and Sustainable development of watershed management projects. Common property resources management, equity issues in watershed management, factors causing inequity, monitoring and evaluation in watershed designing, execution and monitoring tools, Indicators. National Water Policy.

Books:-

1. CGWB- National Water Policy.
2. Lee N and Kirkpatrick C, Sustainable Development and Integrated Approach.
3. Athavale R.N , Water harvesting and Sustainable Supply in India, Centre of Env. Ed.
4. Rajesh Rajora , Integrated watershed management.Pub. Rawat Publication, Jaipur.
5. Upendra Nath Roy , Peoples Participation in Watershed Management, Kanishka Pub.,
6. Reimold R.J. Watershed Management Practices, Policies and Coordination.

PRACTICALS

PRACTICAL-VII
GIS AND DIGITAL IMAGE PROCESSING (4GWM-4)

1. Concept of entity and relationship. Creation of Tables
2. Concept of SQL

3. Performing various actions over table. Merging of tables by using primary key. Maintaining database.
4. Introduction to image processing software. Study of the marginal information given on the C.D. Rom/Digital data
5. Import / Export of files using software. Geo-reference of the toposheet and imageries
6. Display, Analysis and interpretation of black & white images and FCC
7. Study of various contrast enhancement techniques
8. Sub-setting of area of interest from the satellite image
9. Principal Component Analysis
10. Unsupervised Classification
11. Supervised Classification
12. Map composition.

PRACTICAL-VIII
PROJECT (4GWM-5)

Students will have to select the project in consultation with the Course Director. The project provides students with the opportunity to demonstrate their ability to carry out independent research, think and work in an original way, contribute to knowledge, and overcome genuine problems in water management. The student has to submit the report of the project undertaken by him before practical examination.

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