

**S.S.JAIN SUBODH P.G. (AUTONOMOUS) COLLEGE**  
(Affiliated to University of Rajasthan)



**Syllabus**

**Department of Environmental Science**

**P.G. DIPLOMA**

**IN**

**Water Harvesting and Management System  
(PGD-WHMS)**

**As per New Education Policy-2020**

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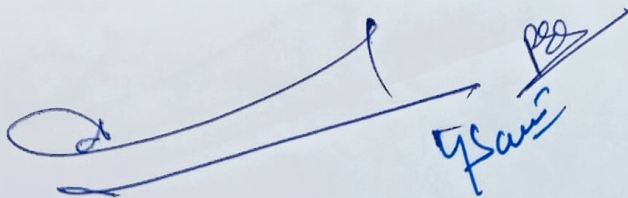
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### **Preamble:**

Industrialization is basically considered for the comfortable living of human beings. We are getting different types of goods and luxuries due to industrial products though, these are positive aspects of industrialization, along with the development in science and technology the calamities related to industries and environmental pollution problems are increasing day by day. Bhopal Gas Tragedy, Chernobyl Accident, Three Mile Island Nuclear Accident, etc. are some of the examples of safety violation. The above mentioned incidences are to enough to understand the severity of Industrial calamities. To avoid such circumstances various laws and orders implementation is necessary but not the fact is that not only laws but proper training and education about safety rules and their implementation are prior requirements for any industry. In this ever increasing era of industrialization, accidents are becoming a part of process and therefore, there is need of qualified and experienced manpower that can handle the complex industrial situations and avoid the calamities. Nowadays, there is high demand for such safety professionals from different industries. In many nations, it has been made mandatory to appoint well trained and qualified professional for the Industry. Every year around 20 students from our college and 100s of students from other Department of Environmental Science complete M. Sc. degree and join Environmental Consultancy or Industry as an Environmental Professional. With their M. Sc. Environmental Science, if they get add-on course as a P.G. Diploma P.G. Diploma in Water Harvesting and Management System (PGD-WHMS). for a person joining industry as Environment and Safety Officer, these students will get immediate entry in the industry and good salary package after completion of their P.G. Considering the present scenario in mind, Department of Environmental Science, propose to start P.G. Diploma in Water Harvesting and Management System (PGD-WHMS). The course is designed for the students and employees from industries who will be exposed to comprehensive and rigorous training covering all areas of Safety, Health and Environmental management.

### **Objectives:**

To develop highly qualified professional manpower the basic requirement lies on systematic quality based coaching and training in Advanced Science and Technologies. Therefore, the course

A large handwritten signature in blue ink, possibly reading 'G. S. S.', is written across the bottom of the page. Above it, there are some initials, possibly 'J. L.', also in blue ink.

is designed to train and provide expert human resource to safety management and expected to bring direct benefits to industry and society. The course is based on following objectives:

- ✓ To develop an expert manpower to handle the complex industrial environment.
- ✓ To give knowledge about occupational health, industrial hygiene, accidental prevention techniques to the students.
- ✓ To make the student aware about safety auditing and management systems, pollution prevention techniques etc.
- ✓ To train the students about risk assessment and management.
- ✓ M. Sc. Environmental Science students will get an add on diploma.
- ✓ It will produce well trained, qualified and expert manpower for the Industrial sector.
- ✓ Better placement opportunity for M. Sc. Environmental Science students.
- ✓ Course will be useful for in-service people from the industry.
- ✓ More interaction between Institution and Industry

#### **Eligibility for Admission:**

A candidate who has secured more than 55% or CGPA of 3.5 in the UGC Seven Point scale [36% or Pass marks for SC/ST/Non-creamy layer OBC/SBC] or equivalent in the Bachelor degree in Science or Engineering or Technology or Medicine or Pharmaceutical Science shall be eligible for admission to P.G. diploma in Industrial Safety Health and Environmental Management course. For candidates from outside state of Rajasthan 60% or CGPA of 4.0 in the UGC Seven Point Scale will be applicable irrespective of the category.

#### **Proposed Course for P.G.D. in Water Harvesting and Management System (PGD-WHMS)**

##### **Academic Duration of Course and Examination:**

The course will complete in one year. The course includes two times internal assessment/Assignments also includes lab work and Industrial training/ relevant institutional training/Consultancy training in authorized consultancies etc.

*S. L.*  
*4 years*

### **Course structure and Scheme of Examination:**

1. Each theory paper carries 100 marks. The internal assessment will be 30 marks and EoSE shall carry 70 marks. The EoSE will be of 3 hours duration. There will be a practical examination of 100 marks in all Semester based on the theory paper/industrial Training.
2. There will be two parts in EoSE theory paper. Part "A" of theory paper shall contain 10 Short Answer Questions of 14 marks, based on knowledge, understanding and applications of the topics/texts covered in the syllabus. Candidate has to attempt seven questions out of 10 and each question will carry two marks for correct answer.
3. Parts "B" of EoSE theory paper will consist of four questions from each unit with internal choice of 14 mark each. The limit of answer will be five pages.
4. Each Laboratory EoSE will be of four hour durations and involve laboratory experiments/exercises/ Seminar presentation Project work or field study / Industrial Training/ consultancy training and viva-voce examination consisting of 100 Marks.
5. The aim of Project work or field study / Industrial Training/ consultancy training is to introduce students to research methodology in the subject and prepare them for pursuing research in theoretical or experimental or computational areas of the subject. The project work or Field Study is to be undertaken under guidance jointly by Head of the Department and a senior faculty or a Scientist or any other suitable person with proven research excellence in the concerned field of study. Project work or field study / Industrial Training/ consultancy training can also be taken up in an outside institution of repute Department. The guide will make continuous internal assessment of the Project work or field study / Industrial Training/ Consultancy training. EoSE for Project work or field study / Industrial Training/ consultancy training and seminar will be held at department of the college by a board of three examiners consisting of HoD, two senior faculty of the department or expert from interdisciplinary department of the institution.
6. Supplementary/ due paper/ special examinations will be resolute as per the institutions autonomous rules
7. Grade/CGPA/percentage/division will be decided as per the autonomous guidelines of the institution.

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Y. S. Sawani  
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### Proposed course for P.G.D. in WHIMS\*

S.No.	Code	Paper Title	Marks		Total
			External	Internal	
1.	WHMS 1	Fundamentals of Water Hydrology and Hydro Chemistry	70	30	100
2.	WHMS 2	Water Management, Climate Change, Case Studies and Legal Aspect	70	30	100
3.	WHMS 3	Geo informatics in Water Resources Management And Tools Techniques	70	30	100
4.	WHMS 4	Watershed conservation and Harvesting Techniques	70	30	100
5.	WHMS 5	EIA, Remote Sensing and GIS for Water Resources Development	70	30	100
6.	WHMS PBT5 A	Practical Based on Theory Paper	60	40	100
7.	WHMS PBT5 B	Practical Based on Training and Visits Project	60	40	100

### Abbreviations Used:

#### Course Category

DSC: Discipline Specific Core  
 DSCP: Discipline Specific Core Practical  
 DSE: Discipline Specific Elective  
 DSEP: Discipline Specific Elective Practical  
 GE : General Elective  
 AEC: Ability Enhancement Course  
 AECC: Ability Enhancement Compulsory Course  
 SEC: Skill Enhancement Course  
 SEM: Seminar  
 PRJ: Project Work  
 RP: Research Publication

#### Contact Hours

L: Lecture  
 T: Tutorial  
 P: Practical or Other  
 S: Self Study

#### Relative Weights

CIA: Class Internal Assessment  
 (Test/Attendance/Classroom Participation/Quiz/Home Assignment etc.)  
 EoSE: End of Semester Examination

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**Proposed course for P.G.D. in WHMS\***

S.No.	Code	Paper Title	Marks		Total
			External	Internal	
1.	WHMS 1	Fundamentals of Water Hydrology and Hydro Chemistry	70	30	100
2.	WHMS 2	Water Management, Climate Change, Case Studies and Legal Aspect	70	30	100
3.	WHMS 3	Geo informatics in Water Resources Management And Tools Techniques	70	30	100
4.	WHMS 4	Watershed conservation and Harvesting Techniques	70	30	100
5.	WHMS 5	EIA, Remote Sensing and GIS for Water Resources Development	70	30	100
6.	WHMS PBT5 A	Practical Based on Theory Paper	60	40	100
7.	WHMS PBT5 B	Practical Based on Training and Visits Project	60	40	100

**Abbreviations Used:**

Course Category

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*Y. S. S.*

## Structure of the Curriculum

S. No.	Code	Paper Title	Course Category	Credit	Contact Hours Per week		EoSE Duration (Hrs.)	
					L	P	Thy	P
1.	WHMS 1	Fundamentals of Water Hydrology and Hydro Chemistry	DSC	6	4	0	3	0
2.	WHMS 2	Water Management, Climate Change, Case Studies and Legal Aspect	DSC	6	4	0	3	0
3.	WHMS 3	Geo informatics in Water Resources Management And Tools Techniques	DSC	6	4	0	3	0
4.	WHMS 4	Watershed conservation and Harvesting Techniques	DSC	6	4	0	3	0
5.	WHMS 5	EIA, Remote Sensing and GIS for Water Resourees Development	DSC	6	4	0	3	0
6.	WHMS PBT5 A	Practical Based on Theory Paper	DSC	6	0	12	0	4
7.	WHMS PBT5 B	Practical Based on Training and Visits Project	DSC	6	0	12	0	4

  
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J. L.

## PAPER - I

### FUNDAMENTALS OF WATER HYDROLOGY AND HYDRO CHEMISTRY

Duration: 3 hrs.

Max. Marks: 70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consists four questions one question from each unit with internal choice. Each question will carry 14 marks.

**OBJECTIVES:** Through this paper students will try to find out and learned the various combined concepts related to the Water and its Chemistry. This will generate their artefacts regarding Hydro Chemistry.

#### UNIT- I

Origin of groundwater, Types of aquifer, Darcy"s law, coefficient of permeability, groundwater flow rates, permeability formulae, laboratory and field measurement of permeability, Groundwater movement Surface water hydrology – rainfall and surface runoff relationship, runoff, runoff characteristics, Water balance.

#### UNIT-II

Introduction to hydro chemistry of water, chemical composition of water samples, structure and bonding of water, Formation of hydrogen bonding, Ionic formula, Ionic ratios, Adsorption and Ion Exchange, Mixing, Oxidation, Reduction, membrane effects

#### UNIT-III

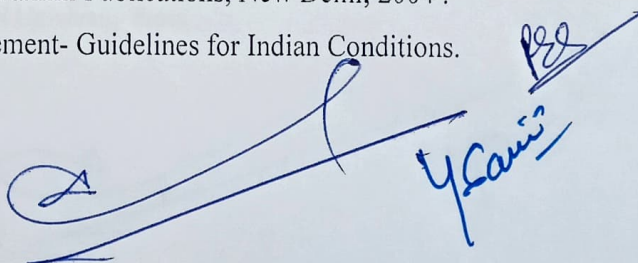
Water quantity/quality assessment and management, Water conservation measures, Water-harvesting structures, Reduction of water losses, different stack holders and their relative importance, Rainfall pits and rain water harvesting, Contour bunding.

#### Unit-IV:

Soil-Conservation Strategies: soil moisture (soil moisture meter, gravimetric method, capacitance probe, Time domain reflectometer, Tensiometer).Concept of land husbandry, Field-level and watershed-level strategies.Indigenous technologies, Soil Erosion Modeling and Soil-Conservation Research.

#### Books:

1. Ravindra Kumar, Fundamentals of Historical Geology.
2. Patra.K.C, Hydrology and Water Resources Engineering, Narosa Publications, 2008, 2nd Edition, New Delhi.
3. Jeya Rami Reddy.P, Hydrology, Laximi Publications, New Delhi, 2004 .
4. Tidewan E.M Watershed Management- Guidelines for Indian Conditions.





## PAPER -II

### WATER MANAGEMENT, CLIMATE CHANGE, CASE STUDIES AND LEGAL ASPECT

Duration: 3 hrs.

Max. Marks: 70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

**OBJECTIVES:** Paper stresses on the present scenario for the management of water with the political aspects of its sharing and generation of the legal framework.

#### UNIT- I

Water conveyance, collection system, water carriage system, and application methods. Changes in water quality, water quality as influenced by potassium and nitrate, Water Quantification, Water and water quality standards:, Desirable limits, Causes of water logging, effects of water logging, prevention of high water table and water logging.

#### UNIT-II

Impacts on water resources – NATCOM Report, Water-related adaptation to climate change in the fields of Ecosystems, Potential water resource conflicts between adaptation and mitigation - Implications for policy and sustainable development.

#### UNIT-III

Water resources assessment case studies – Ganga Damodar Project , Himalayan glacier studies, Ganga valley project - Adaptation strategies in Assessment of water resources- Hydrological design practices and dam safety- Operation policies for water resources projects - Coastal zone management strategies.

#### UNIT- IV

Historical Background And Current Status: Water (prevention and control of pollution) Act 1974, Rules, Fundamental Duties, National and International Framework for Water Law, National level initiatives for regulation of groundwater supply, Transboundary Water Legislation: International Water Law Indus Waters Treaty, India-Nepal Treaty ,Indo-Bangladesh Cooperation, Sharing of Nile and Mekong River Basins

#### Books:-

1. Irrigation water Management-Principles and Practice- D.K Majumdar- Pub. Prentice Hall of India Pvt. Ltd. New Delhi.
2. Tidewan E.M , Watershed Management- Guidelines for Indian Conditions.
3. Domenico, Physical and Chemical Hydrogeology, Wileys
4. Water Law in India- An Introduction to Legal Instruments. 2011. Philippe Cullet and Sujith Koonan Print ISBN-13: 9780198070818, Published to Oxford Scholarship Online: September 2012
5. "The Politics of Water – A Survey", Ed: Kai Wegerich and Jeroen Warner, Taylor and Francis Group, London, 2010.
6. Transboundary Freshwater Dispute Resolution – Theory, Practice and Annotated References, Heather L. Beach et. al., (2000), UN University Press.

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## Paper-III

### Geo Informatics in Water Resources Management and Tools Techniques

Duration: 3 hrs.

Max. Marks: 70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

**OBJECTIVES:** New techniques and ideas for studying water reservoirs by making students GIS enabled in theoretical aspects and later on will teach them to imply all these practically in their future endeavors.

**UNIT- 1 :** Hydrological Concepts: Hydrological Cycle, Types of Precipitation, Measurement of Rainfall, Surface sources, Groundwater sources of water, Type of water distribution system, Methods of Distribution system, Design of distribution system, Analysis of Distribution networks

**UNIT-II:** Watershed Management: Basin types, Watershed characterization, delineation and codification, watershed problems and management strategy based on microzonation using GIS techniques. Geo informatics approach for watershed prioritization Remote Sensing in Surface - Subsurface Water Exploration:

**UNIT-III:** Application of remote sensing in hydrogeomorphological interpretation for ground water exploration. Operational Applications in Water Resources: Geoinformatics Models in Water Resources: Geoinformatics based Runoff and hydrological modeling.

**UNIT-IV:** Spectroscopy, photometry, chromatography, Atomic absorption spectroscopy, Chromatography, TLC – paper and Ionexchange, Electrophoresis, Flame photometry: Complexometric titrations, Principles of Photochemistry.

#### Books:

1. Jayaram Reddy, A Text Book of hydrology, Lakshmi publishers, New Delhi.
2. Subramanya.K, Hydrology for Engineers, Tata Mc Grace Hills, New Delhi, 1984.
3. Todd.D.K. Ground water hydrology; John Wileys & Sons Publications, New York.
4. Ragunath, H.M, Hydrology, Villey tastem publication, New Delhi, 1985.
5. Hem J.D. Study and Interpretation of Chemical Characteristics of Groundwater.
6. Karanth K.R, Groundwater Assessment Development and Management.

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## PAPER IV

### INTEGRATED WATERSHED CONSERVATION AND HARVESTING TECHNIQUES

Duration: 3 hrs.

Max. Marks: 70

**Note:** There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

**OBJECTIVES:** Through the teaching and demonstration patterns of this paper, students will learn the various techniques of watershed management and rain water harvesting.

**Unit-I:** Watershed delineation, Objectives of planning watershed projects, guidelines for project preparation. Gully control, terracing, building check dams, reclamation of soils, Water harvesting-rainwater harvesting and roof water harvesting, Water Harvesting Techniques, Micro-Catchments, Design of Small Water Harvesting Structures.

**Unit-II:** Watershed Management: Project Proposal Formulation, Watershed Development Plan, Entry Point Activities, Estimation, Watershed Economics, Watershed Approach in Government Programmes, Evaluation of Watershed Management.

**Unit III:** Watershed Standard Modeling: approaches and classification, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall runoff process, Introduction to integrated approach.

**Unit-IV** Quality criteria for groundwater supplies- Drinking and Domestic, Irrigation, and Industrial use, water quality monitoring and preventive measures, Trilinear Plots, Piper, Logarithmic diagram-Schoeller, Mixing diagrams.

#### Books:

1. Gender and Water Alliance 2002. The Gender Approach to Water Management: 3TU, UK.  
<http://www.genderandwateralliance.org>
2. Mainstreaming Gender in Water Management, Resource Guide, Version 2.1 November 2006.  
<http://www.genderandwaterresourceguide.org>
3. Ratna V. Reddy and S. Mahendra Dev. (Ed.), 2006, Managing Water Resources, Policies, Institutions, and Technologies, Oxford University Press.
4. Vasudha Pangare, et. al 2006. Global Perspectives on Integrated Water Resources Management: A Resource Kit, Academic Foundation.
5. Standard methods for examination of water and waste water analysis-APHA-AWWA-WEF.

*J. S.*  
*Y. S.*  
*A*

## Paper- V

### EIA, REMOTE SENSING AND GIS FOR WATER RESOURCES DEVELOPMENT

Duration: 3 hrs.

Max. Marks: 70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 14 marks. Each question will carry two marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

**OBJECTIVES:** The main motto of this paper is to ascertain the students about the basic formulation the EIA in water resource management along with their Sustainable Development. The modulation and implementation of these core concepts will enable the mentees to learn and adapt their practical norms in future for the sake of water resources.

**Unit-I:** Physics of remote sensing, Interaction of EMR, Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS. Water resources applications: 4M GIS approach water resources system – Thematic maps - Rainfall-runoff modeling – Groundwater modeling – Water quality modeling - Flood inundation mapping and Modeling.

**Unit-III:** Applications of Remote Sensing and Geographical Information System - Role of Decision Support System, GIS as a watershed tool for developing a watershed management plan, GIS delineation of watershed, Development of a watershed Management plan.

**UNIT-III:** Water resources development and environmental issues, Environment in water resources project planning, EIA notification, Environmental Impact Assessment (EIA) Participation of Public in environmental decision making, Methodologies for EIA.

**UNIT IV:** Environmental Impact Statement (EIS) preparation, Environmental Management Plan: In-stream ecological water requirements - Public participation in environmental decision making – Sustainable water resources development – Ecorestoration – Hydrology and global climate change – Human ecology – Ecosystem services – Environmental monitoring programs.

### Books:

1. Environmental Impact Assessment. Canter, L.W, McGraw Hill International Edition, New York. 1995.
2. Hydrology and global environmental change. Arnel, N., Prentice Hall, Harlow. 2002.
3. Comprehensive Environmental Impact Assessment of Water Resources Projects : With Special Reference to Sathanur Reservoir Project (Tamil Nadu)/K. Discovery Pub., Chari. B., Richa Sharma and S.A. Abbasi. New Delhi, 2005.
4. Lillesand. T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation III Edition. John Wiley and Sons, New York. 1993.
5. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems.,Oxford University Press. New York. 1998.

*S.L.*  
*7/2/2018*  
*7/2/2018*

## PRACTICAL

Laboratory Work /Industrial Visits and Project Report: Candidates are required to work for the Project work or for an Industrial Training or Internship related to the subject at least for 8 weeks and submit the report to the Department. The report will be evaluated by the panel of examiners in the final examination where the candidate shall present their work by Power Point Presentation followed by Vivavoce.

A Project work / Dissertation topic may be allotted by the department

### Dissertation Report Submission Guidelines:

The dissertation report should contain the followings:

1. Dissertation report will contain a cover page, certificate signed by student and supervisor, table of contents, introduction, Objective, Literature review, methodology, results and discussions conclusion, and references.
  - Paper size to be used should be A-4 size.
  - Font size should be 12 with Times New Roman.
  - Text of the dissertation may be typed in 1.5 (one and a half) space.
  - Print out of the dissertation shall be done on both sides of the paper (instead of single side printing)
  - Total no. of written pages in dissertation report should be 40 to 60.
2. The candidate shall be required to submit three hard bound copies of dissertation along with a soft copy emailed to the department as per the date announced.
3. The candidate will defend her/his dissertation/project work through presentation before the External examiner at the end of semester and will be awarded marks.

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