

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



SYLLABUS

DEPARTMENT OF ENVIRONMENTAL SCIENCE

POST GRADUATE DIPLOMA

In

**WATER HARVESTING AND MANAGEMENT SYSTEM
(PGD-WHMS)**

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 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 **Academic Duration of Course and**

Examination:

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

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.

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.

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

| S.No. | Code | Paper Title | Theory Hours | Practical Hours | Marks | | Total |
|-------|-----------|--|--------------|-----------------|----------|----------|-------|
| | | | | | External | Internal | |
| 1. | WHMS 1 | Fundamentals of Water Hydrology and Hydro Chemistry | 4 | 2 | 70 | 30 | 100 |
| 2. | WHMS 2 | Water Management, Climate Change, Case Studies and Legal Aspect | 4 | 2 | 70 | 30 | 100 |
| 3. | WHMS 3 | Geo informatics in Water Resources Management And Tools Techniques | 4 | 2 | 70 | 30 | 100 |
| 4. | WHMS 4 | Watershed conservation and Harvesting Techniques | 4 | 2 | 70 | 30 | 100 |
| | WHMS 5 | EIA, Remote Sensing and GIS for Water Resources Development | 4 | 2 | 70 | 30 | 100 |
| 5. | WHMS PBT5 | Experimental work | | | 60 | 40 | 100 |
| 6. | WHMS PBT5 | Synopsis Preparation | | | 60 | 40 | 100 |

Semester –I

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 consist four questions one question from each unit with internal choice. Each question will carry 14 marks.

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.
5. Murthy J.V.S Water Management in India.

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.

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, 2021.
2. Watershed Management- Guidelines for Indian Conditions, Tidewan E.M , Omega Scientific Publishers, 1996
3. 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
4. “The Politics of Water – A Survey”, Ed: Kai Wegerich and Jeroen Warner, Taylor and Francis Group, London, 2010.

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.

UNIT- I

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. GIS for Water Resource and Watershed Management, John G. Lyon, CRC Press; 1st edition, 2002
2. Geographic Information Systems in Water Resources Engineering, Lynn E. Johnson, ISBN 9780367577421, CRC Press, 2009.
3. Advances In Water Resources Management For Sustainable Use, Roy P.K., Springer, 2021
4. Geo-Informatics in Resource Management and Sustainable Ecosystem, International Symposium, GRMSE 2013, Wuhan, China, November 8-10, 2013, Proceedings, Part II, Fuling BianYichun XieXiaohui CuiYixin Zeng, Springer, 2021

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.

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>.
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.

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.

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-II

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 – Eco restoration – 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. Environmental Impact Assessment: Theory and Practice Author(s) :M. Anji Reddy, BS Publications/BSP Books, 2019.