

**Pre-Ph. D Syllabus
For
Environmental Sciences**

**I K Gujral Punjab Technical University
Kapurthala**

Pre Ph.D course work in Environmental Science

Pre Ph.D course work in Environmental Science will be of 14 credits and shall be offered on regular basis at IKGPTU campus. The structure of the course work is as under

Sr. No.	Code	Nature of Course	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
							Internal	External	
1.		Mandatory	Research Methodology	45	3-1-0	4	30	70	100
2.		Mandatory	Research Publication Ethics	45	2-0-0	2	30	70	100
3.	PHE S-101 PHE S-102 PHE S-103	Core (discipline specified)	Recent Advances in Environmental Science or Soil and the Environment or Disaster Management	45	3-1-0	4	30	70	100
4		Interdisciplinary	Research Seminar			4	-	-	-
			Total		(L-8, T-2, P-0)	14	90	210	300

PROGRAM OUTCOMES:

PO1	To provide in-depth knowledge in an area of specialization, including the current status of the area and what remains to be understood.
PO2	To teach about the importance of literature review, accessing scientific databases, laboratory safety and code of conduct with the view of preparing them for taking up research problems
PO3	To evaluate scientific work critically, by applying, analyzing, synthesizing, and evaluating scientific knowledge
PO4	To communicate scientific concepts, methods, results, and conclusions effectively to the society at large through presentation.
PO5	To develop skills in applicable professional areas, such as pedagogy, teamwork and leadership, through teaching, workshops, interactions with alumni and internships.

PROGRAM SPECIFIC OUTCOMES:

PSO1	To inculcate the research scholars with applied and advanced knowledge associated with subject.
PSO2	To introduce the students with the latest development in the concerned specialization.
PSO3	To impart skill in the handling and operation of instruments and other analytical techniques for solving their research problems.
PSO4	Ability to integrate knowledge and techniques from other scientific disciplines into chemistry research, promoting a holistic approach to problem-solving.
PSO5	Capacity for innovative thinking and problem-solving in tackling complex scientific challenges and developing novel solutions.
PSO6	To integrate the interdisciplinary programme in the concerned area of specialization.

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Subject Code:	PHES-101			
Subject Title:	Recent Advances in Environmental Science			
Contact Hours:	L:4	T:0	P:0	Credits:4
Examination Duration (hours)	3			
Objective(s):	CO1. To provide knowledge and understanding of digital revolution, microplastics, Pops, biological warfare agents and their health hazards CO2. Understanding of sustainable management, AI tool, UAV for abatement of pollution and ecological restoration CO3. Knowledge and understanding of various environmental technologies and Initiative for pollution control			

Unit	Contents
I	Environmental Pollution Electro-smog (5G revolution)-environment and health hazards; Invasion of microplastics and consequences thereof; Emerging environmental contaminants (Pharmaceuticals/POPs); Environmental footprints of digital world; Biological warfare agents-threat to humanity.
II	Environmental Management Economic evaluation of ecosystem services- a way towards sustainability; Artificial intelligence as a tool for management of pollution; Application of UAV (Unmanned Aerial Vehicle) in pollution monitoring and management; Sustainable waste treatment and management; Advances in ecological restoration- rising to the challenges of coming decades,
III	Environmental Technologies Bioremediation technologies - latest trends; Application of membrane technology in pollution control; Best available technology (BAT) for management of persistent organic pollutants; Sustainable green technologies (Green cities and Carbon sequestration); Vermi-technology; Advanced application of remote sensing and GIS; Nanotechnology in pollution control.
IV	Environmental Initiatives National action plan on climate change, Ramsar Convention, Convention on biodiversity development (CBD), Convention on Migratory Species (CMS), Paris agreement IPCC Reports); Sustainable development goals (SDG's); Latest EIA notifications;

References

1. Eddy Y. Zheng (2023). Microplastic Contamination in Aquatic Environments: An Emerging Matter of Environmental Urgency. 2nd edition, Elsevier - Health Sciences Division.
2. Hemen Sarma, Delfina C. Dominguez and WenYee Lee (2022). Emerging Contaminants in the Environment- Challenges and Sustainable Practices. Elsevier.
3. Pablo J. Boczkowski, Eugenia Mitchelstein (2021). The Digital Environment-How We Live, Learn, Work, and Play Now. MIT Press.
4. D. Hank Ellison (2022). Handbook of Chemical and Biological Warfare Agents- Military Chemical and Toxic Industrial Agents. Volume 1, CRC press.
5. Anil Kumar Gupta, Manish Kumar Goyal, Singh, S.P., (2023). Ecosystem Restoration: Towards Sustainability and Resilient Development, Springer.
6. Rathoure .K. Ashok, (2019). Zero Waste: Management Practices for Environmental Sustainability. CRC press.
7. William R. Blackburn (2015) The Sustainability Handbook: The Complete Management Guide to Achieving Social, Economic and Environmental Responsibility. Routledge.
8. Hui Lin Ong, Ruean Doong, Raouf Naguib, Chee Peng Lim, Atulaya K. Nagar. Artificial Intelligence and Environmental Sustainability. Springer.
9. Jha, R.K. (2020). Theory, Design, and Applications of Unmanned Aerial Vehicles. CRC Press.
10. Lindsey (2021). Biodegradation And Bioremediation. Ed Tech Press.
11. Sivasubramaniam, V., (2016). Environmental Sustainability Using Green Technologies.
12. Surajit Mondal, Papita Das, Arnab Mondal, Poushali Chakraborty(2024). Microplastics in the Terrestrial Environment Pathways and Remediation Strategies. Ist edition, CRC Press.
13. Sabu Thomas, Merin Sara Thomas, Laly A. Pothan (2022). Nanotechnology for Environmental Remediation. Ist edition, Wiley-VCH.

Course Learning Outcomes (CLO)

CLO1. Ability to understand and analyze the technology related pollution, microplastics pollution, biological warfare agents and related health hazards

CLO2. Ability to understand the sustainable methods of Environmental management for pollution control and ecological restoration

CLO3. Ability to understand and implement latest environmental initiative and technology for pollution control

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	x	x				
CO2			x			
CO3	x	x				
CO4						

Subject Code:	PHES-102			
Subject Title:	Soil and Environment			
Contact Hours:	L:4	T:0	P:0	Credits:4
Examination Duration (hours)	3			
Objective(s):	<p>CO1. understanding of core principles of soil science.</p> <p>CO2. To provides knowledge of the process of soil genesis and soil orders or groups based on their physico-chemical properties</p> <p>CO3. Identification and analysis of heavy metals and relevant environmental consequences</p> <p>CO4. Ability to understand process of soil erosion its conservation</p>			

Unit	Contents
I	<p>Soil and its components: Soil as component of ecosystems, Soil and man, soil pollution, Texture and structure, bulk density, pore space, soil water, soil air, mineral, organic and chemical components of soil, Interactions between soil components.</p>
II	<p>Soil Development: Rock and their weathering, addition and decomposition of organic matter, processes of soil formation, soil horizons, soil classification and characteristics.</p>
III	<p>Soil properties and Processes: Electrically charged surfaces, Exchangeable cations and cation exchange capacity, Diffuse layer, Selectivity of cation adsorption, Anion retention, sorption of gases, Organic materials sources and decomposition, Soil fauna, soil microorganisms, biological nitrogen fixation, Ammonification, nitrification, denitrification, Oxidation and reduction.</p>
IV	<p>Soil as a medium for plant growth: Plant development and growth, Restrictions to root growth, Requirements of water and nutrients, rhizosphere and mycorrhizas, cultivations, fertilizers, organic manures. Soil acidification, pH and buffering, Percentage base saturation, Processes of soil acidification, Effects of acidity on plants, Acid rain, Acidification of ecosystems, Role of earthworms in soil.</p>

V	Heavy metals and radionuclides in soil: Hazardous elements in soil, Accumulation in soil, Treatment of contaminated land, Radionuclides in soils and their effects on growth of plants
VI	Soil erosion and conservation: Natural erosion, Anthropogenic factors responsible for soil erosion, soil conservation methods. Nitrates, Eutrophication, pesticides, degradation of soils, drought, organic farming and sustaining soil fertility.
VII	Soil analysis: Analysis of particle size, water holding capacity, temperature, pH, conductivity, exchangeable calcium and magnesium, sodium, potassium, Available phosphates, nitrogen, alkalinity, chlorides, sulphates, organic matter, calcium carbonate, boron, standard plate count, microbial activity, heavy metals, pesticides.

References

1. Bohn, H.L., MC Neal, B.L. and O'Connor, G.A. (1979). Soil Chemistry, Wiley Inter science, New York.
2. Trivedi R.K and Goul, P.K. (1987). Practical methods in ecology and Environmental Sciences. Enviro Media Publications, India. White, R.E. (1987). Introduction to principles and practice of soil science, 2nd edition. Blackwell Scientific Publications, Oxford. Wild, A (1993). Soil and Environment: An introduction. Cambridge University Press, Cambridge.
3. Singh, J., Vig, A.P., (2024). Earthworms-Vermicomposting Scope and Application. Kalyani Publishers.
4. Nyle C Brady and Ray R. Weil (2017). The Nature and Properties of Soils. 15th edition. Prentice Hall

Course Learning Outcomes (CLO)

CLO1. Ability to demonstrate the understanding of the core principles of soil science.

CLO2. Ability to describe the process of soil genesis and identify soil orders or groups based on their physico-chemical properties

CLO3. Ability to ascertain relationships between soil processes and relevant environmental consequences

CLO4. Ability to understand soil erosion, its conservation and identification and analysis of heavy metals.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	x	x				x
CO2	x	x				
CO3			x	x	x	
CO4	x	x				

Subject Code:	PHES-103
Subject Title:	Disaster Management
Contact Hours:	L:4 T:0 P:0 Credits:4
Examination Duration (hours)	3
Objective(s):	<p>CO1. Understanding of earth processes, natural cycles and natural hazards.</p> <p>CO2. To provide knowledge of disaster and its types, mitigation approaches, their choices and alternatives</p> <p>CO3. Understanding of disaster management and hazard, risk and vulnerability assessment.</p> <p>CO4. To provide knowledge regarding Disaster management policy</p>

Unit	Contents
I	Concepts and definitions of (disaster - hazard, vulnerability, resilience, risk) Disaster Management (meaning and concept), method and approaches for disaster management- pre-disaster stage (preparedness, mitigation, prevention) and post disaster stage (relief, recovery, rehabilitation)
II	Categories of disasters - natural and manmade Natural disasters (origin, causes and their management) Disaster Profile of India – Mega Disasters of India and Lessons Learnt (Bengal Famine, Bhopal gas tragedy, Bhuj earthquake, Tsunami) Factors affecting Vulnerabilities
III	Flood Risk Mitigation – Causes of Flood; Major floods; Flood vulnerability of India; Flood preparedness and mitigation; IT-tools and techniques of Flood Control; Preventive measures against floods (dams, barrages and embankments); Emergency response during floods; Case study – ‘The Deluge 2000’ (most devastating Flood in South Bengal till date).
IV	Cyclones Causes of Cyclone; its characteristics; Cyclone vulnerability of India; Cyclone preparedness; Forecast and early warning dissemination; Case study – Orissa Super cyclone.
V	Droughts Causes and characteristics of Drought; drought vulnerability of India; Drought preparedness and Mitigation
VIII	Landslides Causes and Characteristics of Landslides; Landslide vulnerability of India; Mitigation measures; Prevention measures
IX	Earthquake Mitigation – Earthquake, its Causes and Characteristic features; Magnitude and Intensity of earthquake; Major earthquakes; Seismic zoning; Earthquake vulnerability of India; Earthquake risk mitigation – Seismic performance examination of RCC Buildings, Retrofitting of vulnerable buildings, Construction of earthquake resistant buildings, Earthquake preparedness; Case study – Bhuj Earthquake.

X	Nuclear Disasters Dos and Don'ts While Commercial Nuclear Disaster, Chemical and industrial Disasters
XI	Disaster Management Policy Environment and local Action – Disaster Management Act 2005; Disaster Management Authority at National, State and District levels; Roles and responsibilities of Govt. Authorities including Local Self Govt. at various levels. Funding for Disaster Management – State Disaster Mitigation fund, State Disaster response fund (SDRF), National Disaster Response Fund (NDRF), Prime Minister National Relief Fund (PMNRF), Chief Minister Relief Fund and Role.

Reference:

1. A Manual on Disaster Management Parag Diwan (2010), Pentagon, Earth.
2. Andrew S., 2003. Environmental Modelling with GIS and Remote Sensing.
3. Bryant Edwards., Natural Hazards, Cambridge University Press, U.K, 2005.
4. Carter, W. Nick., Disaster Management: A Disaster Manager's Handbook; Asian Development Bank, 2008.
5. Damon Coppola., Introduction to International Disaster Management 3rd Edition, 2015.
6. David Etkin., Disaster Theory: An Interdisciplinary Approach to Concepts and Causes, 2014.
7. Disaster Risk Management Systems Analysis: A Guide Book.
8. Stephan Baas (2008), Food and Agriculture Organization of the United Nations.
9. Christian N Madu and Chu-Hua Kuei, Handbook of Disaster Risk Reduction & Management; 2017.

Course Learning Outcome (CLO)

CLO1: Ability to understand the geophysical processes as the drivers of different types of hazards.

CLO2. Ability to appreciate how human activities interface with the geophysical processes in causing and /or accentuating natural hazard.

CLO3. Ability to learn the mitigation approaches, their choices and alternatives.

CLO4. To develop foundations for hazard, risk and vulnerability assessment.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	x	x				x
CO2	x	x		x	x	x
CO3	x	x				x
CO4	x	x				