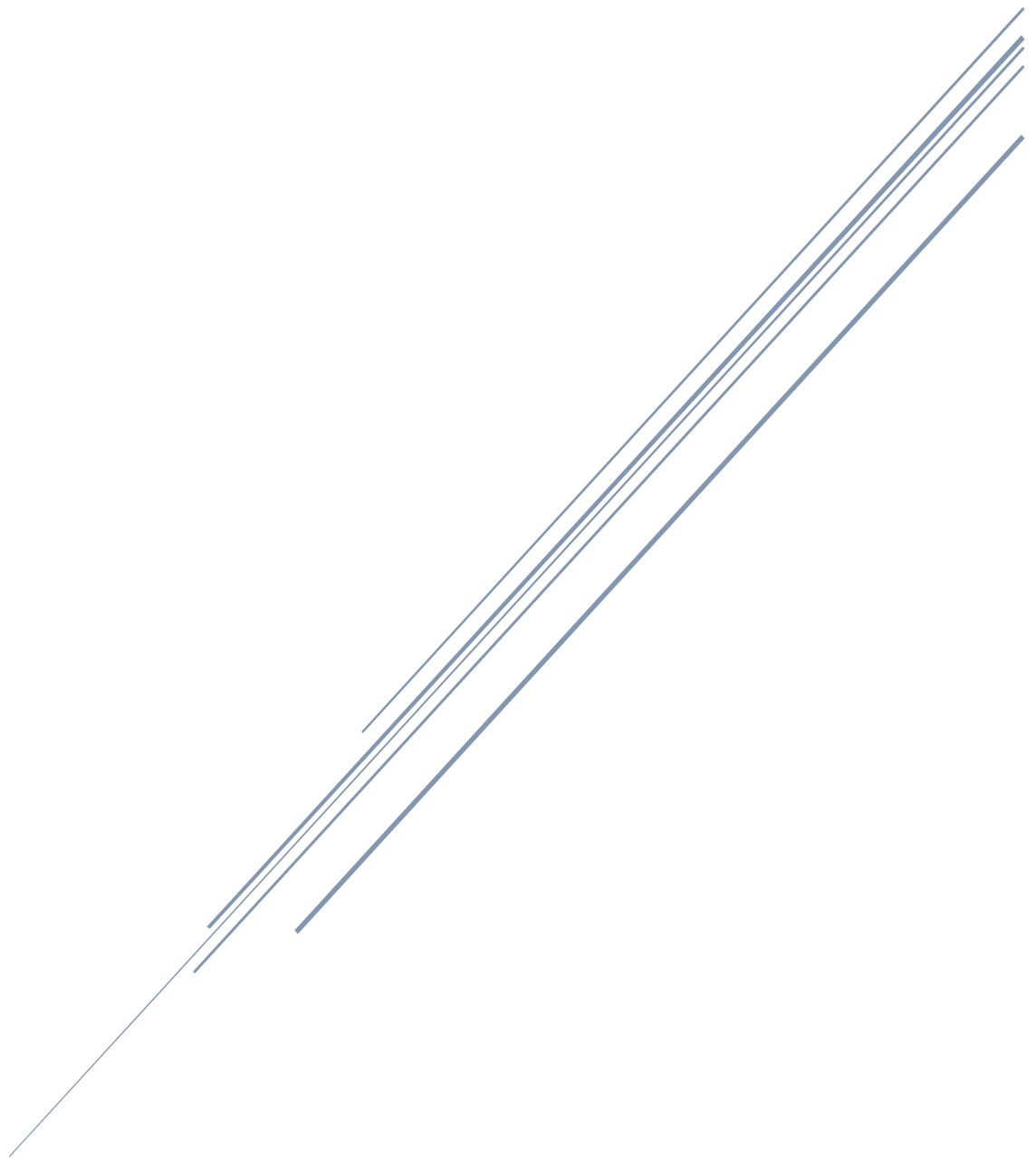


# MASTER OF SCIENCE (ENVIRONMENTAL SCIENCE)-ODL PROGRAMME PROJECT REPORT (PPR)



School of Sciences

PPR of M. Sc. in Environmental Science approved by 39th Academic Council (vide memo no.: Reg/0322 dated 14.03.2023) for delivery of programme through Open Distance Learning mode.

### ***i. Programme's mission and objectives:***

The aim of the postgraduate Environmental Science in ODL programme is to build up environmentalists, who will fight for the environment and help to participate United Nations' sustainable development goal (SDG). The major thrust of this programme will be that the learners will be scientific expertise in the Environmental Sciences, for now, and current future, to mitigate global challenges in the distribution and utilization of natural resources, mitigation of natural hazards, protection of the environment, and significant scientific public awareness. The mission also aims through quality teaching to prepare postgraduate and doctoral students to be absorbed into the industry and academic job, through quality teaching and diverse learning experiences imparted to their fellow students. Through this ODL programme, this knowledge of the environment can be disseminated to the maximum number of students without any formal education liabilities.

#### **Objectives:**

The major objectives of this M.Sc. programme in Environmental Science are:

- ✓ to develop the fundamental concepts and principles of the environment and its conservation among the students
- ✓ develop the skill regarding field techniques, sample collection, mapping and analysis
- ✓ to develop the skill of the students as an environmental professional
- ✓ to motivate the students to take up research and teaching in environmental science
- ✓ to develop a mindset among the students to build and work with NGOs to control environmental issues from the grassroots level

### ***ii. Relevance of the program with HEI's Mission and Goals:***

With increasing public awareness about the environment, the learner also got opportunities for employment and research. With the scientific and industrial revolution with the growth of the global economy, the need for competent graduates with knowledge in environmental science is tremendous in the country and international arena as well. Careers in Environmental Science are so diverse it is difficult to consider them as one category. Masters of this programme can get employment with the education sector, consulting firms, research bodies, government and non-government organisations as Environmental consultants, Environmental project managers, Nature and forest conservation officers, Sustainability consultants, Waste management officers, Pollution control officers etc. Private companies and industries are emphasising more on the science of sustainability after the implementation of environmental law, they are looking for a wide range of professionals to manage the process related to the environment as an environmental safety officer. The programme is also following the goals of NSOU, to promote and develop an appropriate ambience to develop an international standard distance education scenario in our country, keeping in view the demands for the education of the learners in tune with the requirements of the twenty-first century by eliminating the barriers of the conventional learning system

### ***iii. Nature of prospective target group of learners:***

This course is designated for any graduate in science with knowledge of biology (B.Sc. in Environmental Science, any branches of Bio/ Life Science, Chemistry, Geography (B.Sc.), Geology/Earth Science, Mathematics, Statistics (B.Sc), B.FSc., B.Sc. in Agriculture, B.Sc. in Horticulture, BE or B.Tech. in Civil & Environmental Engineering) from any recognized institution/University. Industrial professionals who work as Environmental consultants, Environmental education officers, Environmental managers, Nature conservation officers, Sustainability consultants, Waste management officers, Water quality scientists, etc. can also join this course.

### ***iv. Appropriateness of programme to be conducted in Open and Distance Learning and/or Online mode to acquire specific skills and competence:***

This course is projected for students, researchers and professional practitioners from the interdisciplinary area, who aim to develop their knowledge about the environment. This ODL mode of learning will eliminate all the barriers to learning about the environment and also provide the facility for lifelong learning of environmental science. The course is designed to provide critical and practical skills to analyse, evaluate, design and implement solutions and strategies for environmental issues.

The effective management of environmental resources, environment conservation, and sustainable development are high on the agenda of the United Nation's sustainable development goal. Keeping eye on these challenges requires professionals with a high degree of specialization and an interdisciplinary approach. Applying knowledge gained through environmental science is the only way to solve these problems so that the environment can be preserved. For rapid urbanization and industrialization, the environment needs to be studied constantly in order to avoid unrepairable damage and alteration of the environment significantly. Ultimately, environmental science is necessary to save the environment from the global perspective and all of its dependents from extinction

#### **v. Instructional Design:**

**a. Introduction:** The methodology of instruction at Netaji Subhas Open University (NSOU) is different from that of the conventional/regular programs. Our ODL system is more learner-oriented and the learners took active participation in the teaching-learning process. Most of the instruction is imparted through a blended mode i.e., a combination of distance, as well as face-to-face approach along with that it is based on modern ICT, enabled approach.

NSOU academic delivery system comprises:

**Print Material:** The printed self-learning material (SLM) of the programme is supplied to the students in batches of blocks for every course. These materials are written by eminent teachers/ academicians both from NSOU and other reputed universities/institutions.

**Audio-Visual Material Aids:** The learning package contains audio and video programmes which have been produced by the NSOU for better clarification and enhancement of understanding of the course material given to the student. A video programme is normally 15-20 minutes in duration. The video programmes are available for the students through a laptop/desktop or a mobile app.

**Online/Virtual Classes:** Additionally, NSOU, conducts live/virtual classes using Technology (LMS portal). These are pre-calendared classes where the university faculty or external experts are invited to conduct live sessions for students. Students are able to ask questions and the instructor can answer questions after the lecture using technology.

SLM and other supported study materials are also available in the LMS portal.

**Counselling Sessions:** Normally, counselling sessions are held as per a schedule drawn beforehand by the Learner Support Centre Coordinator. They are held on weekends, i.e., Saturday and Sunday. The Counselling sessions shall be organized in the form of tutorials and not as teaching sessions as the learning materials provided to the learners shall perform the teaching function.

**Laboratory facilities:** The laboratory for practical training for younger minds to get hands-on experience in cutting-edge techniques are available in the dedicated Learner Support Centre (LSC).

b. Course Structure: (Please see the detailed table below):

SEM	Code	Paper	Marks	Assignments	Credit	Total Credit
1 <sup>st</sup>	PGES CC101	Fundamentals of Environmental Science	40	10	4	20
	PGES CC102	Environmental Chemistry	40	10	4	
	PGES CC103	Environmental Biology	40	10	4	
	PGES CC104	Energy and Environment	40	10	4	
	PGES P105	General Practical	50		4	
2 <sup>nd</sup>	PGES CC201	Environmental Pollution, Degradation and control	40	10	4	20
	PGES CC202	Environmental Geosciences and Climate Change	40	10	4	

	PGES CC203	Solid Waste and Hazardous waste management	40	10	4	
	PGES CC204	Risk & Disaster Management and Environmental Safety	40	10	4	
	PGES P205	General Practical	50		4	
3 <sup>rd</sup>	PGES CC301	Environmental Statistics and Environmental Health	40	10	4	20
	<b>PGES DSE302</b>	GIS and Remote Sensing	40	10	4	
	<b>PGES DSE303</b>	Hydrology and Water Management	40	10	4	
	PGES P304	General Practical	50		4	
	PGES P305	Field Visit and Report	50		4	
4 <sup>th</sup>	PGES CC401	Environmental Impact Assessment and Environmental Laws	40	10	4	20
	PGES CC402	Sustainable Development, Environmental Economics and Management	40	10	4	
	<b>PGES DSE403</b>	Environmental Toxicology and Ecotoxicology	40	10	4	
	<b>PGES DSE404</b>	Environmental Microbiology and Biotechnology	40	10	4	
	PGES P405	General Practical	50		4	
<b>Total</b>			850	150	80	
			1000			

a) **Detailed Syllabus:**

**FIRST SEMESTER**

**PGES CC101: FUNDAMENTALS OF ENVIRONMENTAL SCIENCE**

**Marks 50**

**Credit 4**

**Basic concepts of Environmental Science:** Definition of Environment, Scope and Principle of environmental science, Environmental ethics and philosophy; environmental education and awareness; Green politics

**Components of Environment:** Lithosphere, hydrosphere, atmosphere and biosphere; physical and biological environments

**Man, society and environment:** Human civilization processes (Man-Environment relationship); Human settlements, Biogeographic provinces of the world and Ecofeminism

**Current Environmental issues:** Global environmental issues: Biodiversity loss, ozone layer depletion;

Indian environmental issues: environmental movements related issues (Bishnoism, Silent Valley movement, Chipko movement, Appiko movement, Narmada dam, Tehri dam, Almatti dam); River

conservation plan (Namami Ganga and Yamuna Action plan), River linking; conservation of wetland: Ramsar sites in India; Desertification and their control

### PGES CC102: ENVIRONMENTAL CHEMISTRY

Marks 50

Credit 4

**Fundamentals of Environmental Chemistry:** Atoms, Classification of elements, chemical bonds and chemical reactions; Stoichiometry; Gibbs' energy; chemical potential, chemical kinetics and chemical equilibrium

Laws of thermodynamics, the solubility of gasses in water, radioisotopes

**Biological chemistry:** Saturated and unsaturated hydrocarbons and polymer chemistry; chemistry of carbohydrate, protein, fat, nucleic acids, etc; green chemistry – concept, green catalyst; material life cycle and application of green chemistry

**Atmospheric chemistry:** Composition of air; Particles, ions and radicals in the atmosphere; formation of particulate matter in atmosphere, oxygen and ozone chemistry; Photochemical smog

**Water Chemistry:** Fundamental of Water chemistry; Concept of DO, BOD and COD; Sedimentation, Coagulation and Flocculation, pH and redox potential (Eh)

**Principles of analytical methods:** Design of sampling techniques (air, soil, biological matters), Gas chromatography, HPLC, GC-MS; Atomic absorption spectroscopy, Flame photometry, ICP-MS; XRF, XRD, FTIR, SEM, TEM

### PGES CC103: ENVIRONMENTAL BIOLOGY

Marks 50

Credit 4

**Life Processes and characteristics:** Origin of life; role of natural selection, genetic drift, concepts of Gaia Hypothesis

**Ecosystem structure and functions:** Tropic structure and function in ecosystem; productivity; food chain and food webs, energy flow models; ecological succession – causes, trends, of succession, basic types of succession, general process of succession, climax concept; species diversity, concept of ecotone, edge effect, ecological habitats and niche; ecosystem services

**Population and Human ecology:** Population properties and dynamics of population growth, factors controlling population growth; metapopulation; concept of carrying capacity; mechanism of population equilibrium; concept of 'r' and 'K' species, keystone species; Human population growth, expansion and its causes; human demography, future of human population

**Biomes:** Biomes and biome types; characteristics of different biomes: forest, grassland, highland icy alpine biome, tundra, and desert

**Community ecology:** Community structure, factors influencing the structure of communities, community dynamics, species diversity in communities, interspecific interactions

**Biological diversity:** Definition, type and importance of biodiversity, threats to biodiversity; biodiversity hotspot in India, megabiodiversity country; Extinct, rare, endangered and threatened flora and fauna of India; strategies for biodiversity conservation: *in situ* and *ex situ* conservation, national parks, sanctuary, protected areas in India, biopiracy

### PGES CC104: ENERGY AND ENVIRONMENT

**Marks 50**

**Credit 4**

**Energy Resource:** Concept of renewable non-renewable resource, conventional and nonconventional energy resource; Energy use pattern in India

**Nonrenewable or conventional energy resource:** classification and composition of fossil fuels; physicochemical characteristics and energy content of coal, petroleum and natural gas

**Nonconventional energy sources:** principle, importance and basic mechanism of generation: hydro-power, wind power, tidal energy, geothermal energy, OTEC

**Solar Energy:** Sun as source of energy, theory of generation of solar electricity, solar collector; photovoltaic modules; solar pond

**Nuclear energy:** fission and fusion reaction, Nuclear fuels, nuclear reactor: principals and types

**Bioenergy:** bio-mass characteristics; Production of energy from biomass: Problem and prospects

### **PGES P105: GENERAL PRACTICAL**

**Marks 50**

**Credit 4**

1. **Determination of Physico-chemical properties of water:** pH, DO, BOD, COD, free and combined CO<sub>2</sub>, salinity, conductivity, transparency (Secchi Disc method), sulfate, phosphate, nitrate-nitrogen, ammonical-nitrogen, sodium and potassium
2. **Soil properties:** pH, organic matter, N, P, K
3. Study of pond biota – phytoplankton, zooplankton and macrophytes

### **Suggested Books for P.G. Environmental Science (M. Sc.)**

#### **Semester I**

1. *Environmental Science*; S. C. Santra, New Central Book Agency.
2. *Environmental Science*: Enger & Smith. 7th Den, McGraw Hill
3. *Fundamental of Ecology*; E.P. Odum, W.B. Saunders Company, USA.
4. *Concept of Ecology*; E. J. Kormondy, Prentice Hall of India Pvt. Ltd.
5. *Environmental Biology*; Biswarup Mukherjee, Tata McGraw Hill Co. Ltd., New Delhi.
6. *Environmental Geology*; Edward A. Keller, Prentice Hall, New Jersey.
7. *Physical Chemistry*; P.C. Rakshit, Sarat Book House, Calcutta.
8. *Environmental Chemistry*; A. K. De, New Age (p.) Ltd.
9. *Elements of Bioinorganic Chemistry*; G. N. Mukherjee, Arabinda Das, U.N. Dhar & Sons Pvt. Ltd.
10. *Atmospheric Chemistry & Physics*; Sainfeld, John Wiley & Sons. Inc.
11. *The Chemistry of Nanoparticles: synthesis, properties and application*; C.N. R. Rao, A Muller, A. K. Cheetham, Wiley-VCH, Verlag GMBH, Germany.
12. *Elements of Ecology*, Smith and Smith, Pearson Publication
13. *Ecology: Experimental analysis of Distribution and Abundance*, C. J. Krebs, Harper-Row
14. *Ecology and Environment*; P.D. Sharma, 13<sup>th</sup> Edition, Rastogi Publications
15. *A Text book of Environment*; Agrawal, Sikdar and Deb, MacMillan
16. *Environmental Science: Earth as a Living Planet*; Botkin & Keller, John Wiley & Sons

#### **ECOND SEMESTER**

**PGES CC201: ENVIRONMENTAL POLLUTION, DEGRADATION AND CONTROL**

**Marks 50**

**Credit 4**

**Air Pollution:** Natural and anthropogenic sources; Type of pollutants and their transportation; Mixing height, lapse rate, plume behaviour, Gaussian plume model; inorganic pollutants (SO<sub>x</sub>, NO<sub>x</sub>), ozone, SPM, acid rain, odour pollution; organic pollutants, biopollutants; effects of air pollutants; different control measures and Indian ambient air quality standards

**Water pollution:** Sources and types; inorganic and organic pollutants; eutrophication, heavy metals and bacterial contamination; thermal pollution; sewage and groundwater pollution, effluent treatment; General effects of water pollution, control technologies of water pollution

**Noise pollution:** Sources and types of noise; Noise intensity; Noise and noise-indices measurement; Effects control of noise pollution

**Soil pollution:** Sources and types of different pesticides, synthetic fertilizer (N, P&K) etc.; the impact of soil pollutants; management of agricultural pollution in India

**Thermal Pollution:** source of thermal pollution, heat islands, causes and consequences

**Marine Pollution:** sources of marine pollution and its impacts; control and management of marine pollution; coastal zone management

**Radiation pollution:** sources of radioactive pollution; biological effects of ionizing radiations; pollution from nuclear weapons' explosions, from electric power generation plant and nuclear reactors

**PGES CC202: ENVIRONMENTAL GEOSCIENCES AND CLIMATE CHANGE**

**Marks 50**

**Credit 4**

**Fundamentals of Earth processes:** Origin of Earth; Geological time scale; Structure of earth's crust, Geotectonics; Continental drift and mountain building with reference to plate tectonics; Landforms developed due to water, wind and glacier

**Rocks and minerals:** physical and engineering properties of rocks; distribution of important minerals and rocks in India; different types of rocks: igneous, metamorphic and sedimentary

**Soil:** Soil formation, external geomorphic processes: weathering and erosion; sediments and sedimentation; identification and characterization of clay minerals; cation exchange capacity; soil sampling and analysis, soil contamination, soil conservation and management.

**Fundamentals of climatology:** Scale of meteorology; Elements of climate; Coriolis force, pressure gradient force, frictional force; Spatial and temporal patterns of climatic parameters in India, Indian monsoon, Climatic regions of India based on Koeppen's classification

**Climate Change:** Climate change and national action plan on climate change; green buildings; GRIHA Rating Norms; COPs

**PGES CC203: SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT**

**Marks 50**

**Credit 4**

**Waste management:** Types, sources and generation of wastes, their characterization, chemical composition; methods of disposal and management of wastes; integrated waste management; Energy from waste

**Municipal solid waste management:** composition; on-site disposal; incineration; open dumping; sanitary landfill; environmental consequences, sewage fed fisheries; composting

**Hazardous waste:** sources, types and characteristics; oxidation-reduction, solidification; handling and management of radioactive waste; environmental impacts

**Biomedical waste:** generation and characteristics; segregation; Different management practices: colour codes; disposal and treatments

**E-waste:** sources, classification, methods of handling and disposal; environmental impacts

**Fly ash:** source and composition; fly ash utilization and disposal

**Plastic waste:** source consequences and management; Bioplastics

#### **PGES CC204: RISK & DISASTER MANAGEMENT AND ENVIRONMENTAL SAFETY**

**Marks 50**

**Credit 4**

**Natural disaster management:** Natural Hazards: floods, landslides, earthquake, volcanism, tsunami; IDNDR viewpoint; disaster studies – Indian scenario; role of information science and technology for natural disaster reduction; natural disaster mitigation *vis-à-vis* risk and vulnerability

**Environmental safety and Health protocols:** Concept of Risk; Risk assessment methodologies; Hazard-risk evaluation and management; environmental safety measurements; Industrial safety measures and management; fire safety protocols

#### **PGES P205: GENERAL PRACTICAL**

**Marks 50**

**Credit 4**

1. Macroscopic and microscopic identification of igneous, sedimentary and metamorphic rocks, common minerals; Study of fossils with reference to paleo-environment
2. Handling of meteorological data recording equipment; Meteorological parameters: Temperature, moisture, humidity, light, wind speed
3. Air pollution sampling device- demonstration of the operating principle of High Volume Sampler, estimation of dust particles, ambient air quality.
4. Measurement of noise level
5. Plankton collection and counting
6. Demonstration of vegetation frequency, density, abundance, cover and basal area, dominance, Importance Value Index (IVI) and phytography
7. Effect of pesticides on opening and closing of stomata of different crops

#### **Suggested Books for P.G. Environmental Science (M. Sc.)**

##### **Semester II**

1. *Environmental Geology*; Edward A. Keller, Prentice Hall, New Jersey.
2. *Geology Environment Society*; K., S. Valdiya, University press
3. *Environmental Meteorology*; B. Padmanabha Murthy, I.K. International
4. *Coping with natural hazards: Indian Context*; K.S. Valdiya, Orient Longman .
5. *Environmental Geology*, C.W. Montgomery, Mc. Graw Hill International.
6. *Soils – their properties & management*; Peter E. V. Charman, Oxford Univ. Press.
7. *Introductory Soil Science*, D.K. Das, Kalyani Publishers.
8. *Environmental Noise Pollution and Its Control*, Chhatwal, Mehra Katyal, Satake Katyal, Nagahiro, Anmol Publications (Pvt.) Ltd., New Delhi.



9. *Environmental radiation and thermal pollution and their control*, G. R.Chhatwal et al., Anmol Publications (Pvt.) Ltd., New Delhi.
10. *Understanding environmental pollution*; Marquita K. Hill, Cambridge University Press, 1997.
11. *Air pollution and climate change*; Alan Wellburn-2<sup>nd</sup>Edn., Longman,1998

### THIRD SEMESTER

#### PGES CC301: ENVIRONMENTAL STATISTICS AND ENVIRONMENTAL HEALTH

**Marks 50**

**Credit 4**

**Environmental statistics:** Basic elements and tools of statistical data analysis, bivariate and multivariate data; statistical measures -- mean, median, standard error and deviation; Distribution: normal, t and  $\chi^2$ , poisson and binomial; testing of hypothesis: t-test,  $\chi^2$  test and ANOVA; level of significance, degree of freedom; probability; derivations and integrations, matrix

**Environmental health and health hazards:** Concept of health and disease; principles of epidemiology; epidemiology of communicable and non-communicable diseases – brief notes; occupational health (Silicosis, Asbestosis, cardio-respiratory problem); communication for health education; health planning and management; National health programs

**Environmental health monitoring:** Application of Bio-sensor, sensor species, sensor-based monitoring

#### PGES DSE302: REMOTE SENSING AND GIS

**Marks 50**

**Credit 4**

**Basic principles of remote sensing-:** Classification of map, commonly used map projections; Electromagnetic radiation, remote sensing process; physics of radiant energy; energy source sources and radiation principles; energy interactions in the atmosphere; scattering; energy interaction with earth surface materials; an ideal remote sensing system

**Remote sensing platforms and sensors:** Satellite system parameters; resolutions; imaging sensor systems- active and passive; different types of satellite with special emphasis on Indian remote sensing satellites

**Digital image processing:** The basic character of the digital image; image classification- supervised and unsupervised

**Principles of GIS:** Spatial data representation – Raster, Vector, Spatial objects and their relationship, Essential elements of GIS, GIS functions, Advantages of GIS, Linking between GIS and RS.

**Environmental Application of Remote sensing and GIS:** Fundamentals of GPS; Application of remote sensing in different fields: Land use and land cover mapping and planning, agricultural, watershed mapping, climate change monitoring, disaster management and forestry application

#### PGES DSE303: HYDROLOGY AND WATER MANAGEMENT

**Marks 50**

**Credit 4**

**Hydrological cycles and process:** hydrological cycle; precipitation, evaporation, transpiration, runoff, infiltration; types of water

**Groundwater hydrology:** origin of groundwater; genetic classification of groundwater; Aquifer types; Water table and piezometric surface; Aquifer properties: porosity; void ratio, specific retention, hydraulic conductivity; transmissivity, specific yield, storativity; Darcy's law and its validity; groundwater velocity; Elasticity of confined aquifer, Land subsidence

**Water resources management:** World water balance, groundwater provinces in India; safe yield and overdraft, groundwater depletion, cause, effects; climate change impacts on water resource management; rainwater harvesting and artificial recharge; watershed management

**PGES P304: General Practical**

**Marks 50**

**Credit 4**

1. Interpretation of geological and topological maps
2. Satellite image interpretation
3. Survey a specific area through GPS
4. Problems related to groundwater assessment
5. Hydrological map interpretation
6. Mean, median, mode, correlation and regression-based of environmental data
7. Demonstration on rainwater harvesting and watershed management system

**PGES P305: Field Visit and Report**

**Marks 50**

**Credit 4**

Report preparation of at least 2 days of field visit, based on common landforms/ mining/ industry process/ human settlement and adaptability

**Suggested Books for P.G. Environmental Science (M. Sc.)**

**Semester III**

1. *Statistics for environmental Biology and Toxicology*; W. W. Piegorsh & A. J. Bailer.
2. *Environmental Statistics and data analysis*; Ott, W. R., Lewis Publishers, New Jersey.
3. *Statistical Methods*; G. W. Snedecor & W. G. Cochran.
4. *Fundamental of Physical Geography*; Majid Husain, Rawat publications
5. *Remote sensing and GIS*; Basudeb Bhatta, Oxford publisher
6. *Basic of Remote sensing and GIS*, S. Kumar
7. *Remote sensing and image interpretation*, Lillesand, Kiefer and Chapman, Wiley publisher
8. *Fundamental of Remote Sensing*, George Joseph, University Press

**FOURTH SEMESTER**

**PGES CC401: ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL LAWS**

**Marks 50**

**Credit 4**

**Environmental Impact Assessment:** Origin of EIA, Aims and objectives of EIA; principle and characteristics of different EIA processes and their relationship; EIA guidelines and notifications (EIA, CRZ, IPZ), Basic steps for environmental clearance of projects

**EIA techniques and methods:** Evaluation of methodologies, different methods -- Ad Hoc, Checklist, Overlay, Matrix, use of Computers & expert system; Environmental Management Plan, EIA and planning and management; Environmental Audit System

**Environmental Policy and Conventions:** National Policy regarding environmental protection, National and International Conventions and Treaties, Administrative and Legislative framework for environmental protection

**Environmental Law:** Provisions in the constitution of India regarding Environment (Article 48A and 58A); Wildlife Protection Act, 1972 amended 1991; Forest Conservation Act, 1980; Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988; The Environment (Protection) Act, 1986 and Rules 1986; Disaster Management Act, 2005; Noise pollution (regulation and control) Rules, 2000; Hazardous and other waste (Management and Trans boundary Movement) Rules, 2016; The Solid waste management Rules, 2016

#### **PGES CC402: SUSTAINABLE DEVELOPMENT, ENVIRONMENTAL ECONOMICS AND MANAGEMENT**

**Marks 50**

**Credit 4**

**Environmental Economics:** Concept of ecological economics; environmental economics and principles; cost-benefit analysis; the economics of environmental quality; Carbon sequestration and carbon credits; Polluter pays principles; trade and environment; externalities; Environmental Kuznets Curve (EKC)

**Environmental Management System:** concept and scope of Environmental Management; Environmental Management system principles, tools and management strategies; perspectives of environmental management policy in India, ISO Systems; Ecomark; Ecolabelling and auditing, Life Cycle Assessment, Green trade.

**Sustainable Development:** Sustainability indices; Strategies on sustainable development; Concept of Sustainable Agriculture; Sustainable development in practice; Urbanization; Urban resources and environmental problems; carrying capacity analysis; Ecological footprint.

#### **PGES DSE403: ENVIRONMENTAL TOXICOLOGY AND ECOTOXICOLOGY**

**Marks 50**

**Credit 4**

**Toxicology:** Principles of toxicology; elements and areas of toxicology; acute and chronic toxicology; dose-response relationship; interaction of toxicants with organ, the statistical concept of LD<sub>50</sub> and LC<sub>50</sub>; chemical and biological factors and their influences, bioassay methods, routes of entry of toxicants

**Toxic responses:** General toxic responses on the cellular level, nervous system, gastrointestinal tract, liver, kidney; bioaccumulation and bio magnifications

**Immunology and immune toxicity:** Properties of immune response; innate and acquired immunity; cells and organs of the immune system; concepts of antigens; the concept of antibodies with special reference to structure, function, classification; major histocompatibility complex; cell-mediated and hormonal immunity

**Biochemical aspects potentially toxic elements (PTE):** Sources, distribution, mechanism of action, effects and remedial measures of some metals and metalloids

**Genetic toxicology:** Types, mode of action of carcinogens, mutagens, teratogens

#### **PGES DSE404: ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY**

**Marks 50**

**Credit 4**

**General Microbiology:** Bacterial morphology: shape, size; Plasmid and chromosome; fungal morphology; Microbes of air, water and soil; Isolation, characterization and microbial growth analysis

**Food Microbiology:** Contamination and microbial spoilage of fresh food and its preservation; food adulteration; fermented food; food poisoning; bacterial infections and intoxications, viral food borne illness

**Application of Biotechnology** Pollution detection and abatement; Biosensor, microbial biosensor, gas-phase biosensor, Nano biosensor, environmental application of biosensor; agriculture application: Bio-fertilizer: types and application in agriculture; bio-pesticides; bio-composting; integrated pest management- concept; GMO and its merits and demerits

#### **PGES P405: General practical**

**Marks 50**

**Credit 4**

1. Study on strain/ morphology of bacteria Gram staining of bacteria
2. Collection, isolation and population study of microorganisms in air, water and soil
3. Bioassay Measurement (LC<sub>50</sub>/LD<sub>50</sub>)
4. Study on toxicological lesions viz. Histopathological (fish), GIT, Liver, Kidney
5. Identification of pathogens
6. Estimation of Chlorophyll, total sugar content of different crops
7. Estimation of total protein content of plant and animal
8. Biochemical responses: Estimation of Proline, Ascorbic acid and protease activity

#### **Suggested Books for P.G. Environmental Science (M. Sc.)**

##### **Semester IV**

1. *Environmental Impact Assessment*, Canter, L. McGraw Hill
2. *Environmental and Social Impact Assessment: An Introduction*; Barrow, John Wiley & Sons
3. *Casarett & Doull's Toxicology*; The basic Science of poisons, 2nd Den, Editors, J. Doull, C.D. Klaassen, M.O. Amdur, Macmillan Publishing Co. Inc., NY. Edn. John Doull, Curtis D
4. *Fundamentals of Ecotoxicology*, 3<sup>rd</sup>Edn., Michael C Newman, CRC Press, Taylor & Francis Group, London,, 2010
5. *Principles of Biochemical Toxicology*; 3 Edn, JoghTimbrell, Taylor & Francis, 2000
6. *Environmental Toxicology*; David A Wright, and Pamela Welbourn, Cambridge University Press, 2002
7. *Environmental Impact Assessment: A Guide to Best Professional Practices* (HB) Taylor & Francis(CRC)

8. *Environmental Biotechnology (PB): CBS; Allen, K*  
 9. *Toxicants in the aquatic ecosystem, T. R. Crompton, John Wiley & Sons, NY. Cell and Molecular Biology; EDP De Robertis, EMF De Roberts, Jr, International Edition, 1988*

## c. Faculty &amp; Support Staff requirement:

The NSOU has government-sanctioned posts of teachers and non-teaching staff for academic and administrative support for the learners effectively and cohesively. The recruitments of faculty positions are always strictly maintained following the UGC guidelines. The University also take support from the wider academic community of the respective courses from other institutions of higher learning and research. The details of internal faculty members and officers are available on the University Website viz. [www.wbnsou.ac.in](http://www.wbnsou.ac.in)

Sl. No.	Faculty	Name of the Faculty	Work at (HQ/RC)	Number
1	Professor	Dr. Samit Ray	RC - 1	1
2	Associate Professor	Shri Pranab Nath Mallik	RC - 1	1
3	Assistant Professor	Mr. Niladri Sekhar Mondal	RC - 1	1

## d. Support Staffs:

Sl. No.	Office Staff (Designation)	Work at (HQ/RC)	Number
1	Junior Assistant	HQ - 1	1
2	Junior Assistant Cum Typist	RC - 1	1

## e. Instructional Delivery Mechanisms:

Mode of Delivery/ Types	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
Face to Face Mode	PCP	Yes	18 Hrs for 50 Marks/ 4 Credits – Theory 36hrs for 50Marks/ 4Credits- Practical
	Tutorials/ Special Classes/ Remedial Classes/ ECP	Yes	Online Classes are provided as per requirements (about 10-15 hrs per batch)
	Seminar/ Research Colloquium	Yes	12 hrs
	Laboratory based practical	Yes	216 hrs practical
	Field work including visits	Yes	8-10 days
Self- Learning	SLMs	yes	As per the requirement of the students
	Reference Books		
ICT/ Digital Wellness of students	Online (Web driven/Mobile App )	Yes	As per the requirements of the students
	Offline DVD/SD Card/USB Drive	No	
	Telecommunications	Yes	Support services are given
Blended	Smart Classrooms	Yes	Available at RCs and used as per requirements
	Flipped Learning	Yes	It was supported for the students benefits

**vi. Procedure for admissions, curriculum transaction and evaluation:**

University frames its policy related to admission entry criteria, method of admission, conduction of admission through the Admission Committee (statutory body) following the guideline of the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 and Department of Higher Education, Govt. of West Bengal. Admissions are conducted entirely through Online mode centrally by the University.

**Information Circulation Policy:**

All information related to the programme like admission policy, eligibility, fee structure, course curriculum, medium of instruction, method of instruction, evaluation method, SLMs etc. are transacted through prospectus, brochure, official notification etc.

**Learner Support Services:**

Learner support services are provided by the University at three level of functioning of the Open University architecture i.e. Learner Support Centre (LSC), Regional Centre and Head Quarter.

Following the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 LSCs are provide various learner support services in order to facilitate the acquisition of teaching-learning experience for its enrolled learners throughout at various phases of learners' study life cycle. LSC also main contact points for access by the learners, responsive and facilitating information centres, arranging contact sessions and other operations like processing of assignments etc.

University has constituted Learner's Facilitation Centre (LFC) at each Regional Centres to provide various support services. Beside that University has also provided learners support services through web based platform/ telephone/ email/ instant messaging services.

**Transaction of Curriculum and Academic Planner:**

The University employs a variety of strategies to maximize the exposure of students to course material and each instructional programme. Initially, printed SLMs/SIMs (Self Learning Materials/Self Instructional Materials) packages and contact programmes including face-to-face engagement with academic counsellors are offered. Ultimately, audio materials, audio-visual presentations, teleconferences, and sporadic discussion sessions through webcasting and online radio may be implemented. The following instructional Learning Methodologies and Student Support Services are utilised to improve the Open and Distance learning environment:

- SLM in Print
- eSLM on the University Website
- Live AV Lectures Using LMS platform integrating App based education
- AV Lectures in DVD Mode; subsequently integrated on NSOU android app (Over 40 hrs run time)
- Blended Learning through PCP at LSC and online instruction
- SLP

Curriculum transaction is through Online and or Offline modes as detailed above and all academic activities are conducted following the programme is following the below mentioned activity planner during the academic session:

Name of the Activity	Tentative months schedule (specify months) during Year	
	From (Month)	To (Month)
Admission	Nov	Jan
Distribution of SLM	Jan	Mar
Contact Programmes (counselling, practical, etc.)	Apr	Nov

Name of the Activity	Tentative months schedule (specify months) during Year	
	From (Month)	To (Month)
Assignment Submission	Oct	Nov
Evaluation of Assignment	Nov	Dec
Examination	Dec	Jan
Declaration of Result	Mar	Apr
Renewal/ Re-registration	Jan	Feb

**Evaluation:**

Evaluation is on a 2-tier basis, divided into Assignment submission (online mode) and Term End Examinations (Offline mode). The weightage is as follows:

Assignment – 20 marks

Term End Examination – 80 marks

Total marks for each course – 100

**Assignment / Internal Assessment/ Continuous Assessment / Formative Assessment:** Assignment submission is the first interaction between the learner and the teacher. It has a very important role to play in the teaching-learning process in distance education. So, submission of Assignment is mandatory for all learners. The assignment responses reflect what the learners have understood and learnt. The assignment answer scripts are returned to the learners so that the assignment answers serve the purpose of providing feedback to the learners and inform them their strengths and weaknesses. Learners will be required to submit assignment for each course and the marks obtained on evaluation of those assignment courses will be entered into his/her individual record of performance. This will constitute 30% (maximum) of the Full marks in the course as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) regulations, 2020. All the Marks secured by the learners will be progressively entered into the result card. Every learner is required to submit the assignment courses before each Term-End Examination. In practical course of Science stream, there is no assignment.

**Term-End Examinations:** Minimum 80% of the total credit points of the course (except practical course where it is 100%) would be reserved for Term-End Examination as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020. Minimum qualifying marks in each course is 20% (Term End Examination Marks + Assignment Marks).

In the case of Practical course, Dissertation, Field Work Report and Viva-Voce 100% weightage is reserved for the Term-End Examination

**Waive of Programme Fee:**

University waive of full course fee for transgender learners.

**vii. Requirement of the laboratory support and Library Resources:**

The University and the Learner Support Centres (LSCs) have designated laboratory space to meet the curriculum requirements of the program and skill up the students. NSOU maintains a well-equipped Central Library and Departmental Libraries with an adequate number of prescribed textbooks and reference books in Environmental Science, CDs, Encyclopaedias and Journals. In addition, Self-instructional material in sufficient quantity is available in the library. E-library facilities were also available at Durgapur R.C. and Jalpaiguri R.C.

Library facility is one of important services in any higher educational institution. In addition to the Self Learning Materials (SLMs) and other learning resources the University provides library facility to all of

its registered learners. The Library Department, Netaji Subhas Open University is located at Kalyani Campus.

Further, to cater to the needs of huge number of registered students, the University needs unlimited libraries to provide educational support to everyone. To cope with the situation, the University has initiated the process of setting up a strategic partnership with the existing network of Public Libraries that are available in the State of West Bengal to offer educational support to our learners all over the State. This initiative taken by NSOU is the first of its kind in the country.

#### **viii. Cost estimate of the programme and the provisions:**

Total course fee is Rs. 18,300/- (Excluding Examination and Studentship Renewal Fees). An approximate distribution of expenditure is given below to get prior view:

Assigned Head	Sub Head	% of Expenditure
Development	SLM Preparation and Development Cost	7
	SLM Printing	44
Maintenance & Programme Delivery	Maintenances Grant	5
	Counselling/ PCP/ Lab Counselling	25
	Delivery Charges	4
	Other Overhead Expenses	8
ICT Support	Admission Processing	1
	ICT Support Services	5
	Computer Training	1

#### **ix. Quality assurance mechanism and expected programme outcomes:**

University is supported with a strong group of Board of Studies (BOS) members. All highly competent and esteemed professors have constantly supported this programme to cater to equitable quality education. They are engaging their self in time-to-time reviewing of syllabus. They do moderation and in such a way this BOS is responsible to check and maintain the quality of this program. NSOU has constituted the "Centre for Internal Quality Assurance (CIQA) as per UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 to ensure the delivery of high quality programmes to its learners.

**Board of Studies (BOS):** Board of Studies ensure quality of the Curriculum of Post Graduate Programme in Environmental Science as per University norms. BOS plays a vital role as the following

- ✓ Curriculum review and development of quality Self Learning Materials (SLMs) in print. The curriculum is reviewed regularly to ensure that it is up-to-date and relevant to the needs of learners.
- ✓ Learner's assessment and evaluation process through a variety of methods, including exams, assignments. This helps to ensure that Learners are meeting the learning outcomes of the Programme.

#### **Expected Programme outcomes:**

After completion of the PG Programme master program (M.Sc.)students will

- ✓ be able to understand and develop the concepts, ideas and responsibilities of higher studies
- ✓ have a good understanding of modern tools and techniques and their uses
- ✓ be able to use their analytical skill to interpret and solve the individual and social problems
- ✓ be able to develop themselves as good researchers, teachers as well as a human being