

UNDER CHOICE BASED CREDIT SYSTEM

(w.e.f session 2021-2022)

**MASTER OF
SCIENCE (MSC)
PROGRAMME**

IN

Environmental Science

(For SEM I & SEM II)

SIDHO-KANHO-BIRSHA UNIVERSITY

Curriculum

MASTER OF SCIENCE (MSc) PROGRAMME IN

ENVIRONMENTAL SCIENCE

(w.e.f academic session: 2021-2022)

	Course Code	Course Title	Credit	Marks
SEM I	MENVSCCT101	Fundamentals of Environment	4	40+10
	MENVSCCT102	Physical Environment	4	40+10
	MENVSCCT103	Environmental Biology	4	40+10
	MENVSCCT104	Environmental Microbiology	4	40+10
	MENVSCCS105	Practical on Physical Environment	4	50
	MENVSCCS106	Practical on Environmental Biology	4	50
SEM II	MENVSCCT201	Ecotoxicology & Physiological Processes	4	40+10
	MENVSCCT202	Environmental Geoscience	4	40+10
	MENVSCCT203	Energy Resource & Environmental Statistics	4	40+10
	MENVSCCT204	Environmental Pollution & Degradation	4	40+10
	MENVSCCS205	Practical on Environmental Problems	4	50
	MENVSCCS206	Practical on Ecotoxicological Measurements	4	50
SEM III	MENVSCCT 301		4	40+10
	MENVSCCT 302		4	40+10
	MENVSMET303		4	40+10
	MENVS OET304	OPEN ELECTIVE	4	50
	MENVSCCS305		4	50
	MENVSOPS306	OUTREACH PROGRAMME	4	50
SEM IV	MENVSCCT401		4	40+10
	MENVSCCT402		4	40+10
	MENVSMET403		4	40+10
	MENVSACT404	ADD-ON COURSE	4	50
	MENVSCCS405		4	50
	MENVSMEP406	Project & Dissertation	4	50

Semester I

MENVSCCT101

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

FUNDAMENTALS OF ENVIRONMENT

I. Environmental awareness: Definition, Principles and scope of environmental science; Environmentalism; Environmental ethics and philosophy; Environmental education and awareness; Ecofeminism; Green govt. politics [10]

II. Components of environment: Lithosphere, hydrosphere, atmosphere and biosphere; Physical and biological environments
Socio-Cultural Environment: Human civilization processes (man-Environment relationship), society, class, gender; Human settlements [10]

III. Ecology and Biomes: Concept of ecosystem; Ecological energetics; Food chain & webs; Ecosystem structure and functional aspects; Landscape ecology & ecological interactions; Ecosystem services; Biomes and biome types: forest, grassland, tundra, desert biomes; Concept of Gaia Hypothesis [10]

IV. Population ecology and Human ecology: Population properties and dynamics of population growth, factors controlling population growth, metapopulation; Mechanism of population equilibrium
Human population growth, expansion and its causes; Consequences of population growth and affluence; Human demography, promotion and development, demographic transition; Future of human population [10]

MENVSCCT102

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

PHYSICAL ENVIRONMENT

I. Fundamentals of Earth processes: Origin and evolution of the Earth; Geological time scale; Continental drift and mountain building with reference to plate tectonics

External geomorphic processes: Weathering and erosion; Soil - origin, nature and classification of parent material for soil formation, classification of soil; Landforms developed due to various geomorphic agents i.e., water, wind and glacier [8]

II. Fundamentals of climatology: Scale of meteorology; Elements of climate – solar radiation, atmospheric temperature, pressure, wind, moisture, fog & dews, clouds and precipitation; Global atmospheric circulation; Weather analysis and forecasting; Climatic classification; Climatic regions of India, Indian monsoon [8]

III. Environmental chemistry: Chemical bonds and chemical reactions; Rate of reaction, rate law, adsorption - physisorption and chemisorption, adsorption-isotherms, organic compounds – hydrocarbons and polymer chemistry; Biological chemistry – chemistry of carbohydrate, nucleic acids, enzymes; Green chemistry – concept, green catalyst; Material life cycle and application of green chemistry [12]

IV. Principles of analytical methods: Design of sampling techniques (air, soil, biological matters); Principles of analytical methods – Chromatography, HPLC, GC-MS; Atomic absorption spectroscopy, Flame photometry; Spectrophotometry, Electrophoresis, TGA, XRF, XRD, NMR, FTIR, SEM & TEM [12]

MENVSCCT103

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ENVIRONMENTAL BIOLOGY

I. Evolution: Fundamentals of evolutionary processes; Origin of life; Modern synthesis: Role of natural selection, genetic drift, evolutionary divergence, patterns of speciation, population genetics [08]

II. Biological diversity: Brief accounts of microbes (air, water & soil), plants and animals; Principles of taxonomy – nomenclature, an outline of classification and identification [07]

III. Community ecology: Community structure, factors influencing the structure of communities, community dynamics, species diversity in communities, pattern in communities; Ecological succession – causes, trends, of succession, basic types of succession, general process of succession, climax concept, community restoration, chaos and limit cycles, community stability [15]

IV. Systems based modelling techniques: Types of models, dynamic (SIR model, prey-predator models) and static models (ENA); Introduction to basic software on modeling; Optimal foraging theory, chaos and limit cycles, community stability [10]

MENVSCCT104

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ENVIRONMENTAL MICROBIOLOGY

I. General microbiology: General idea about bacterial morphology -- shape, size, structure; Chemistry and function of capsule, pilus, membrane, cell wall, plasmid and chromosome, replication of bacterial nucleus; fungal morphology; Distinctive properties of virus, nucleic acids, life cycle pattern of bacteriophages; Major waterborne and airborne diseases [15]

II. 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, types of microorganisms used, pasteurization [05]

III. Microbial transformations of pesticides: Fundamental reactions of pesticide metabolism; Major steps of biotransformation, e.g., B-oxidation, oxidative dealkylation, decarboxylation, epoxidation, etc.; Hydrolysis, halogen reactions, nitro reactions; Basic ideas on microbial kinetics [10]

IV. Microbial transformations of potentially toxic metals (PTMs): Microbes in metal containing habitat, metal-microbes interactions, microbial immobilization and transformation of metals, microbial application of metal removal [10]

MENVSCCS105

Total lecture hours: 40

Credits: 4 (8P) :: Marks: 50 [I.A.(10) + E.T. (40)]

PRACTICAL ON PHYSICAL ENVIRONMENT

1. Measurement and preparation of Oxygen Profile in aquatic ecosystem
2. Macroscopic and microscopic identification of igneous, sedimentary and metamorphic rocks, common minerals; Study of fossils with reference to paleoenvironment
3. Morphometric analysis of drainage system
4. Handling of meteorological data recording equipment; Construction of wind rose
5. Physicochemical analysis of water and soil parameters
 - a) Meteorological parameters: Temperature, moisture, humidity, light
 - b) Soil parameters: pH, organic matter, N, P, K; Cation Exchange Capacity (CEC)
6. Laboratory Note book
7. *Viva-voce*

MENVSCCS106

Total lecture hours: 40

Credits: 4 (8P) :: Marks: 50 [I.A.(10) + E.T. (40)]

PRACTICAL ON ENVIRONMENTAL BIOLOGY

1. Estimation of abundance: Quadrature counts, line transects and distance method
2. Spatial pattern analysis and indices of dispersion
3. Determination of species diversity by diversity indices
4. Collection, isolation and population study of microorganism in air, water and soil
5. Study of pond biota – phytoplankton, zooplankton and macrophytes; and staining of plankton
6. Laboratory Note book
7. *Viva-voce*

Suggested Book list for Environmental Science in M. Sc.

Semester I

- Environmental Science* — S. C. Santra, New Central Book Agency.
Environmental Science; Cunningham & Saigo WCB McGraw Hill, 1999-5th Den.
- Environmental Science: Enger & Smith. 7th Den*, McGraw Hill
Fundamental of Ecology, E.P. Odum, W.B. Saunders Company, USA.
Concept of Ecology, E. J. Kormondy, Prentice Hall of India Pvt. Ltd.
Environmental Biology, Biswarup Mukherjee, Tata McGraw Hill Co. Ltd., New Delhi.
- Ecology a bridge between science & society*, by E. P. Odum, Sinauer associates
- Environmental Geology*, Edward A. Keller, Prentice Hall, New Jersey.
Physical Chemistry, P.C. Rakshit, Sarat Book House, Calcutta.
Environmental Chemistry, A. K. De, New Age (p.) Ltd.
Fundamentals of Environmental Chemistry, Manban, S.E., Lewis Publishers.
- Elements of Bioinorganic Chemistry*, G. N. Mukherjee, Arabinda Das, U. N. Dhar & Sons Pvt.Ltd.
- Atmospheric Chemistry & Physics*, Sainfeld, John Wiley & Sons. Inc.
Chemistry for Environmental Engineering, Sway, MCarthy & Parkin ; Tata Mc. Graw-Hill.
- The Chemistry of Nanoparticles: synthesis, properties and application* C. N. R. Rao, A Muller, A. K. Cheetham, Wiley-VCH, Verlag GMBH, Germany.
- Principles of Systematic Zoology*, E. Mayr and Peter D Ashlock, McGRAW-HILL, INC
- Principles of Animal Taxonomy*, G G Simpson, Columbia University Press
- Elements of Ecology*, Smith and Smith, Pearson Publication
- Ecology: Experimental analysis of Distribution and Abundance*, C. J. Krebs, Harper-Row
- Ecology*, Ricklefs and Miller, Freeman 4th Ed.
- Microbiology*, Pelzer, M. J. Chan, E.C.S. and Kreig, N. R. McGraw-Hill Publishing Company.
- Wastewater Microbiology*, Bitton, G., John Wiley, NY.

Semester II

MENVSCCT201

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ECOTOXICOLOGY & PHYSIOLOGICAL PROCESSES

I. Toxicology: Principles of toxicology; Elements and areas of toxicology; Acute and chronic toxicology; Dose-response relationship; Statistical concept of LD₅₀ and LC₅₀; Chemical and biological factors and their influences, bioassay methods, routes of entry of toxicants; Interaction of toxicants [12]

II. Biochemical aspects of heavy metals: Sources, distribution, mechanism of action, effects and remedial measures of some heavy metals like arsenic, cadmium, lead, mercury, aluminium, chromium [08]

III. Biochemical aspects of some specific industrial toxicants: Sources, distribution, mechanism of action, effects and remedial measures of some specific toxicants like MIC, pharmaceutical active compounds (PACs) [8]

IV. Enzymology and Immunology & Immunotoxicology: Basic concepts of enzyme kinetics; Mechanism of enzyme action
Properties of immune response; Innate and acquired immunity; Cells and organs of immune system; Concepts of antigens; Concept of antibodies with special reference to structure, function, classification; Antigen antibody interaction, major histocompatibility complex; Cell mediated and humoral immunity; Effects of toxicants on immune system, toxicant-induced autoimmunity & immunosuppression [12]

MENVSCCT202

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ENVIRONMENTAL GEOSCIENCE

I. Land resources and management: Land resources, land degradation cycle, land-use pattern, land reform, land use plan, soil surveys in relation to land use planning; methods of site selection and evaluation [06]

II. Water resources management and its environment: World water balance, surface water and groundwater and their interaction; Environmental factors affecting groundwater level fluctuations, water quality, use of water, conservation of water resources, climate change impacts on water resource management [06]

III. Mineral resources and environment: Geology and mineral resources; Distribution of mineral resources in India; Environmental impact of mineral development; Recycling of mineral resources; Minerals and sustainability [08]

IV. Environmental meteorology: Atmospheric stability, adiabatic character; Turbulence and diffusion, application of meteorology to air pollution study [06]

V. Environmental climatology: Climatic change in of recent times; Identification and characteristics of bio-climatic and agro-climatic regions of India; Urban Climate: Concept of Heat Island; Climate and human comfort [08]

VI. Natural hazards: Earthquakes, Landslides, Cyclones & Tornadoes, Floods and Lightning – Origin, effects and minimization and perception of hazards in Indian context [06]

MENVSCCT203

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ENERGY RESOURCE & ENVIRONMENTAL STATISTICS

I. Energy and environment: Energy budget of the earth; Earth's thermal environment and seasons; Sun as a source of energy, solar radiation and its spectral characteristics

Conventional energy sources: Fossil fuels; Nuclear energy - fission and fusion; Non-conventional energy sources: Solar, hydropower wind, geothermal and ocean energy, energy from biofuels, biogas and biomass, energy use patterns in different parts of the world and India and its impact on the environment [16]

II. Energy management: Energy consumption; Energy conservation, increased efficiency, and cogeneration, energy policy, integrated energy management (energy-audit & green-audit), management of nuclear energy wastes, some conservation factors, research and development on renewable energy. [08]

III. Environmental statistics: Basic elements and tools of statistical data analysis, bivariate and multivariate data; Statistical measures - mean, median, standard error and deviation; Testing of hypothesis: Null and alternative hypothesis, parametric and nonparametric test; Level of significance, degree of freedom, t-test; probability; ANOVA [16]

MENVSCCT204

Total lecture hours: 40

Credits: 4 (4T) :: Marks: 50 [I.A.(10) + E.T. (40)]

ENVIRONMENTAL POLLUTION & DEGRADATION

I. Air Pollution: Criteria pollutants; National Ambient Air Quality Standard; Motor vehicle emissions; Status of air pollution in Indian cities; Different control measures; Indoor air quality - exposure assessment, infiltration and ventilation; Indoor air quality model [08]

II. Water pollution: Sources, types and consequences; Inorganic and organic pollutants; Concept of eutrophication, DO, BOD, COD; Sewage and groundwater pollution; Status of water pollution in different water bodies with reference to Indian context; Water purification techniques [07]

III. Noise pollution: Sources of noise, types of noise; Noise and health; Sonic boom; Noise measurement; Measurement of noise indices (Leq, L10, L90, L50, LDN, TNI); Control of noise pollution; Noise mapping and modelling; Impact of noise and vibrations on human health [08]

IV. Radiation pollution: Radioactivity in the environment; Radiation exposure and radiation standards, radiation protection; Biological effects of radiations; Pollution from electric power generation plant and nuclear plants, thermal pollution – Sources, causes and consequences [07]

V. Soil pollution: Sources, effect of soil pollution on biota, surface water and groundwater regimes; Impact of different pesticides (herbicides, insecticides, fungicides, nematicides, rodenticides *etc.*); Synthetic fertilizer (NPK) [10]

MENVSCCS205
Total lecture hours: 40
Credits: 4 (8P)
Marks: 50 [I.A.(10) + E.T. (40)]

PRACTICAL ON ENVIRONMENTAL PROBLEMS

1. Analysis of Water parameters: Salinity, conductivity, sulfate, phosphate, nitrate-nitrogen, ammoniacal-nitrogen, residual chlorine, sodium and potassium
2. Ambient air sampling, monitoring and analysis
3. Measurement of noise level by noise meter in different zones (as per CPCB guidelines)
4. Laboratory Note book
5. *Viva-voce*:

MENVSCCS206
Total lecture hours: 40
Credits: 4 (8P)
Marks: 50 [I.A.(10) + E.T. (40)]

PRACTICAL ON ECOTOXICOLOGICAL MEASUREMENTS

1. Measurement of LC_{50}/LD_{50} and safe concentration of xenobiotics/toxicants
2. Impact of agrochemicals on hydrophytes, xerophytes and mesophytes
3. Effect of pesticides on total sugar content of different crops
4. Effect of pesticides and heavy metals on total protein content of different crops and aquatic vertebrates
5. Lay out of experimental design (RBD; split-plot etc.); Cluster analysis; Sampling techniques and statistical analysis of experimental design
6. Laboratory Note book
7. *Viva-voce*

Suggested Book list for Environmental Science in M. Sc.

Semester II

Toxicants in the aquatic ecosystem, T. R. Crompton, John Wiley & Sons, NY.

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.

Statistics for environmental Biology and Toxicology, W. W. Piegorsh & A. J. Bailer.

Environmental Geology, Edward A. Keller, Prentice Hall, New Jersey.

Geology Environment Society, K., S. Valdiya, University press

Environmental Metereology, B. Padmanabha Murthy, I.K. International Atmosphere, Weather and Climate, Roger G. Barry Richard J. Charley, Routledge (Taylor & Francis group)

Coping with natural hazards: Indian Context, K.S. Valdiya, Orient Longman .

Environmental Geology, C.W. Montgomery , Mc. Graw Hill International.

Environmental Statistics and data analysis, Ott, W. R., Lewis Publishers, New Jersey.

Statistical Methods, G. W. Snedecor & W. G. Cochran.

Statistics for environmental Biology and Toxicology, W. W. Piegorsh & A. J. Bailer.

Soils – their properties & management, Peter E. V. Charman, Oxford Univ. Press.

Introductory Soil Science, D.K. Das , Kalyani Publishers.

Environmental Noise Pollution and Its Control, Chhatwal, Mehra Katyal, Satake Katyal, Nagahiro, Anmol Publications (Pvt.) Ltd., New Delhi.

Environmental radiation and thermal pollution and their control, G. R. Chhatwal *et al.*, Anmol Publications (Pvt.) Ltd., New Delhi.

Elements of the nature & properties of soils, Nyle C Bardy, Prentice Hall, New Jersey.

Understanding environmental pollution, Marquita K. Hill, Cambridge University Press, 1997.

Air pollution and climate change, Alan Wellburn-2nd Edn., Longman, 1998.