

Bhakta Kavi Narsinh Mehta University, Junagadh



P. G. full time program on
M. Sc. Environmental Science

Proposed By

DEPARTMENT OF LIFE SCIENCES

Bhakta Kavi Narsinh Mehta University, Junagadh,
Gujarat

Syllabus Sem-1 and 2

Effective from June, 2021

• About Department

Department of Life Sciences (DLS) was established in the June 2017, under the Bhakta Kavi Narsinh Mehta University, Junagadh. The Department of Life Sciences has broad vision of carrying out high quality of research in the areas of life sciences. The objective is overall development and betterment of society, students and young researchers. The stated mission of the department is to work towards the generation of skilled human resources for future India. This will be achieved by undertaking cutting edge research using state of art technology in the fields of plant stress physiology, marine biology, biodiversity, genetic diversity, phytoremediation, medicinal plants, toxicology, heavy metal contamination, biotechnology, animal behaviour, entomology cancer biology, environmental biology and climate change.

The university has been successful in recruiting faculties with high level competence in research in fields of plant stress physiology, environmental biology, medicinal plants, environmental biotechnology, immunotechnology, haematology, marine biology, avifauna, macrofauna and macro invertebrates. The department is aiming to becoming “Centre for Excellence” for training and capacity building with dynamic requirements in the field of plant sciences, microbiology and animal sciences.

The department has a very good and pleasant atmosphere for learning. Our aim is always to focus on different dimensions of the students. The department brings us together with remarkably supportive faculty members and students. The faculty aims to inspire the students; a culture characterized by integrity, mutual respect, passion and hard work. LIFE (Life sciences Initiative in the Field of Environment) is society of staff-students of the department and is being co-ordinated by the office bearers. LIFE organizes curricular, co-curricular and extra-curricular activities for the overall development of the students. It provides the platform to the members for sharing their thoughts and current news related to the biological world.

• About Environmental Sciences

The Environmental Sciences is one of the pioneering centres of environmental research and education. The man-environment relationship indicates that pollution and deterioration of the environment have a social origin. Environment pollution has become a major global concern. Global society is facing the challenge of improving and providing of solution the quality of air, water, soil, environment and maintaining the ecological balance. The growth of industrialization, urbanization, modern agricultural development and energy generation has resulted in the indiscriminate exploitation of natural resources for fulfilling human desires and needs, which has contributed in disturbing the ecological balance on which the quality of our environment depends. In recent time, one of the major issues is the threat to human life from the progressive deterioration of the environment. Today we have environmental problems such as acid rain, ozone depletion, global warming, climate change, effects of pesticides and fertilizer, Solid waste, hazardous waste-Treatment & disposal. Roots of these problems are a lack of adequate awareness, knowledge, and understanding of our environment. Sustainable development emphasizes the use of natural resources and employing eco-friendly technology for production, processing, and operation in industries and making societies ready for environmental development and management. The Department of Environmental sciences is offering M.Sc. in Environmental Sciences was introduced during the academic year 2021-22 to support the basic research understanding in the field. Environmental Sciences is a multidisciplinary, interdisciplinary M.Sc. in Environmental Sciences covers ecology; ecosystem; biodiversity; natural resources; environment and energy; environmental pollution; pollution control technology; environmental monitoring and assessment; green technology; environmental laws and regulation; instrumentation and statistics; Industrial hygiene and safety; environmental toxicology; environmental biotechnology and nanotechnology; sustainable development and management.

Vision:

- To enhance global visibility and leading role in environmental policy making by means of modern education, research, awareness and futuristic policies through nurturing the best young minds.

Mission:

- To educate students for serving the society through advanced learning about various environmental processes and materials.
- To nurture critical thinking of the youths and engage them in innovative environmental research.
- To link degree education with entrepreneurship through skill development approach.
- To facilitate the students by all possible means to make them a world class human resource.

The Course

- The course is full time course comprising of four semesters. There will be four theory papers and one combined practicals in first two semesters. The last two semesters offer choice of courses to the students where three core courses and one elective (to be chosen from three available) courses will be taught. Any elective course will be taught only when prerequisite number of the student enrolls for that course. Students shall be required to submit at the time of practical examination at the end of each semester.
 - The laboratory Journal and diary of field work (Tour report) duly signed by the teachers concerned from time to time.
 - A set of assignments, submissions, preparations or materials illustrating the subject - matter as per syllabus for each semester.
- **Seminars / Assignments / Submission**
 - Regular seminars will be organised and it is compulsory. Presentation on relevant topics, mostly from syllabus (oral and / or poster), is mandatory for the enrolled student. For each seminar, a student will be given marks (internal marks)
- **Attendance**
 - Admitted students have to attend all the Lectures, Practical and Seminars. A minimum prescribed attendance as per University rules is required to sanction a term grant. Students whose term is not granted will not be allowed to appear in the examination, and will have to join the same semester in the following year.
- **Eligibility**
 - The candidate with B.Sc. degree in any science subject with minimum 45% is eligible for admission to M.Sc. Environment Science program.

- Students will be admitted as per the reservation policy in effect from time to time, as directed by the University.

- Semester wise distribution of marks**

- SEMESTER-I: 4 Papers (100 Marks each*) : 400
 1 Combined Practical : 200
Total : 600

- SEMESTER-II:
 4 Papers (100 Marks each*) : 400
 1 Combined Practical : 200
Total : 600

*** 70 external + 30 internal**

Opportunities

If interest in research & further study, person could be a academician, researcher or an educationist, and further go for corporate jobs in various companies like Steel, Cement, Pharma, Agro based, Power plant, mines, Refineries etc. or you can work in government sector like Environment & Energy department, state pollution control board or Central pollution control board. Candidate can also join an NGO and become a social activist.

Fee Structure for M. Sc. Environmental Sciences at Department of Life Sciences Sem-I (2021-22)

Sr. No.	Fee Particulars	Amount
1.	Tuition Fee	20000
2.	Admission Fee	150
3.	Library	200
4.	Laboratory	250
5.	Registration	200
6.	University Development Fee	200
7.	Sports Fee	70
8.	Cultural Activity Fee	70
TOTAL (Rs.)		21140

Credit calculation for M. Sc. Environmental Science Semester I

Paper Core Courses	Name of Courses	Credit
EnS101/C	Basic Environmental Science	04
EnS102/C	Environmental Biology (Ecology)	04
EnS103/C	Nature of India's Environment	04
EnS104/C	Statistics and Computational Application	04
Prac105/C	Combined Practical	08

Semester II

EnS201/C	Air and Water Pollution	04
EnS202/C	Environmental Pollution	04
EnS203/C	Environmental Chemistry	04
EnS204/C	Instrumentation and Analytical Technique	04
Prac205/C	Combined Practical	08

Semester	Total Credit score
A, Semester I	24
B, Semester II	24
C, Semester III	24
D, Semester IV	24

Total Credit Score (A+B+C+D) = 96

SEMESTER-I

EnS. 101/C Basic Environmental science

Unit-I: Basics of Environment:

Understanding our Earth and its Environment: Structure of Earth, Atmosphere, Hydrosphere, Lithosphere and Biosphere. Earth's climatic zones and biomass. Climate change, Precipitation: Rain, snow, dew, mist and fog

Unit-II: Atmosphere:

Atmosphere: Composition, structure and functions of atmosphere, atmospheric chemistry, classification of elements, earth's energy budget, reactions in the lower and upper atmosphere, radioactivity in the atmosphere, atmospheric stability, inversions and mixing heights, wind roses

Unit III: Hydrosphere:

Hydrosphere: Structure and properties of water and their environmental significance, distribution of water in earth, fresh water and its chemistry, solubility of gases in water, role of water in environment

Unit-IV: Marine Chemistry and Lithosphere:

Marine chemistry: seawater properties and its constituents, nutrients and salts, Metallic and non-metallic mineral resources like manganese nodules etc.

Lithosphere: Factors and processes of soil development, soil types and their formation, soil profiles, physical and chemical properties

EnS. 102/C Environmental Biology (Ecology)

Unit-I Basics of Ecology, Energy and Biogeochemical cycles:

Basic concepts of Ecology: Definition, Scope of Ecology. Matter and energy in the environment, Laws of thermodynamics. Principle and concept of Ecosystem: Energy in ecosystem, concept of productivity, food chain, food web and trophic levels. Biogeochemical cycles: Gaseous cycles, hydrological cycles and Sediment cycles Role of microbes in nutrient cycles.

Unit-II Habitats, Development and Population Ecology:

Habitats in the ecosystem: Fresh water, marine, estuarine, terrestrial and deserts. Ecological pyramids; limiting factors, laws and combined concept of limiting factors, Development and evolution of the ecosystem. Ecotone and edge effect, Ecades, ecotypes. Population dynamics, Communities, Species interaction.

Unit-III Biodiversity:

Biodiversity: Origin, speciation and extinction and ecological role of biodiversity. Types of biodiversity, alpha, beta, and gamma diversity.

Rare and endangered species: IUCN, Red Data Book. Causes of Biodiversity loss. Conservation of biodiversity (Forest & wildlife): Conservation theory, conservation practices, protected areas and protected species.

Unit IV Microbial Ecology:

Natural environment of microorganism; terrestrial, aquatic and extreme environments. Microbial flora of soil; Rhizobium, Azotobacter, Azospirillum, Cyanobacteria, Azolla, etc. Interaction of microbes with plants, animals and other microbes.

EnS. 103/C Nature of India's Environment

Unit I Basis of Natural Resources:

Introduction to Natural Resources (Land, Resources, Grassland, Biodiversity, Agriculture, Human & Livestock) and Common Property Resources CPRs)

Land Use Classification - Agro-Climatic Regions, Agro-Ecological Regions, Bio-Climatic Regions, Agro-Meteorological Regions

Unit II Energy Resources:

Energy Resources-Introduction, Energy Resources, Basic Concept, Types, Origin, Conventional, Non-Conventional and Perpetual Sources of Energy
Various Energy Resources- Solar Energy, Wind Energy, Tidal Energy, Biogas Energy, Geo-thermal Energy, Environmental Implications, Fuel Cells, and Hydrogen Cells.

Unit III Water and Mining resources:

Concept of hydrological cycle, monsoon distribution, surface & ground water resources, utilization for various purposes, River valley projects, Effect of dams (Narmada, Tehri and Almetti)

Mining-The Concept, Types, Process and Environmental Impacts of Mining, Processing the Minerals and Restoration of Mining Sites

Unit IV Forest and wildlife Resources:

Area, distribution and types of forest, forest cover, major/minor forest products, Problems of over grazing, fuel wood.

Social forestry with particular reference to Gujarat, Chipko & Appiko movement, silent wally movement,

EnS. 104/C Statistics and Computational Application

Unit I Basics and concept of biostatistics:

Data, Tabulation, Classification, Frequency distribution and Graphics

Measure of Central tendency- Mean, Mode and Median; Definition, objectives, Merits Demerits and uses

Measure of Dispersion- Range, variance Standard deviation, coefficient of variation
Confidence limit and confidence interval

Unit II Statistical tests

Student's t-test; pair and unpaired, analysis of variance, Regression and correlation analysis, Chi-square test

Unit III Environmental models

Introduction to environmental system analysis; approaches to development of models

Models of population growth and interactions- lotka- volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model

Unit IV Computational tools & Techniques

General awareness and use of popular software and packages, Internet-Browsing, Microsoft office,

Multivariate analysis: factor analysis, Cluster variable, Time series/ trend analysis by SPSS, Minitab

SUGGESTED PRACTICALS

1. GLP (Good Laboratory Practices)
2. Study of cleaning and sterilization of glass ware
3. Preparation of Standards solutions/ reagents
4. Estimation of CO₂ from waste water
5. Estimation of O₂ from waste water
6. Physical properties of soil texture
7. Physical Properties of water Colour, order, turbidity, etc.
8. Estimation of pH, EC, TDS, TSS from soil and water
9. Staining Techniques
 - a. Monochrome Staining
 - b. Negative Staining
 - c. Grams's Staining
 - d. Endospore Staining
10. Isolation techniques of microorganism from water, soil and air sample
11. Quadrates and Species identification
12. Demonstration of wildlife resources
13. Case study of Endangers species
14. Classification of climatic regions
 - A), Agricultural,
 - B) Biological,
 - C) Meteorological
15. Study of Meteorological Instruments
16. Performance and analysis of
 - A) chi-test,
 - B) T-test,
17. Perform ANOVA
18. Environmental Modelling
19. Factor analysis and Cluster variable analysis,
20. Time series and trend analysis by SPSS, Minitab
21. Other relevant practical

SEMESTER-II

EnS 201/C Air and Water Pollution

Unit I Basics and Air Pollution:

Definitions of Pollution and pollutant, types and origin, classification of pollutants, General concept

Air pollution: Composition of air, Major sources, Types and Properties of pollutants, behaviour and fate of pollutants, Chloro-fluoro carbons in ozone layer depletion, greenhouse gases and concept of global warming, its origin, status and means to control

Unit II Air pollution: Meteorological effect and control Methods

Temperature lapse rates and stability, wind velocity and turbulence, plume behaviour and dispersion of air pollutants

Sampling and measurement of air pollutants, control methods and equipment

Unit III Water Pollution: Freshwater and Thermal

Water pollution: Introduction, definition of water pollution, types and sources of water pollutants and their effects, waste water treatment.

Thermal pollution: Introduction, Concept of thermal pollution, sources of thermal pollution, thermal power plant pollution, hazardous effects, long-term impact, thermal effects on marine life, effects on water quality, prevention of thermal pollution

Unit IV Water Pollution: Control and Treatment

Water treatment (types, methods of waste water treatment: Preliminary, Primary, Secondary and Tertiary: Removal of suspended and dissolved solids, nitrogen and phosphorous, advanced biological system, chemical oxidation, recovery of materials from process effluents), purification of water.

EnS 202/C Environmental Pollution

Unit I Soil and Solid waste Pollution

Soil pollution: Introduction, importance of soil, composition of soil, soil pollution by different wastes (industrial wastes, urban wastes, agricultural practices, chemical and metallic pollutants, sewage and domestic waste)

Solid waste pollution: Introduction, waste generation, Indian scenario, municipal wastes, agricultural wastes and sewage sludge, industrial wastes and mining wastes, hazardous wastes, biomedical waste.

Unit II Soil and Solid Waste Pollution: Control and Management

Control of soil pollution, preventive measures, Integrated Pest management, Integrated Nutrient management, introduction of Organic Farming and Bio-fertilizers, restoration of degraded lands

Solid waste management: Introduction, management of municipal, agricultural, industrial, mining, biomedical hazardous waste, waste treatment methods (Incineration, pyrolysis) and management practices

Unit III Marine Pollution

Pollution of Marine Environment: Sources and nature of pollutants, oil pollution, metallic pollutants, status of coastal and estuarine pollution in India, Chemicals and drugs from oceans, cause, effect and control

Unit-IV Noise and Radioactive Pollution and Control

Noise Pollution: Introduction, Sources of noise, characteristics of sound, measurement of noise, types of noise, effects of noise pollution, Indian ambient noise level standards, prevention and control of noise pollution

Radiation Pollution: Introduction, types of radiation and radioactivity, source and effect.

EnS 203/C Environmental Chemistry

Unit I Fundamentals of Environmental Chemistry

Fundamentals of Environmental Chemistry stoichiometry, Gibbs energy chemical potential chemical equilibrium acid base reaction solubility product, solubility of gases in water the carbonate system on saturated and saturated hydrocarbons radionuclides

Unit II Water Chemistry

Chemistry of water, concept of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), sedimentation, coagulation, filtration redox potential

Unit III Soil Chemistry

Physico-chemical as bacteriological sampling as analysis of soil quality, Soil micro-organisms and their functions, Degradation of different insecticides, fungicides and weedicides in soil

Inorganic and organic compounds of soil, Nitrogen Pathways and in NPK in soil

Unit IV Toxic chemicals in the environmental

Pesticides in water biochemical aspect of arsenic, cadmium, lead, Mercury, carbon monoxide, Ozone (O₃) and PAN pesticides insecticides, MIC carcinogens in the air

EnS. 204/C Instrumentation and Analytical Technique

Unit-I Electrochemistry and Microscopy

Electrochemistry : pH and buffers, EC, Refractometry

Principle and application of light, phase contrast, fluorescence

Scanning and transmission electron microscopy, fixation and staining

Unit-II Chromatography

Principle and application of paper, Thin layer chromatography, gel- filtration, ion-exchange and affinity chromatography; High pressure liquid chromatography (HPLC), Gas chromatography

Unit-III Spectroscopy

Basics of Titrimetry, Gravimetry, Colorimeter, Flame photometry

Basic principle and application; UV-vis spectroscopy, IR and ESR spectroscopy, X-ray diffraction and Atomic absorption spectroscopy (AAS)

Unit-IV Centrifugation and other analytical Technique

Basic principle and application of centrifugation: Differential, density and Ultracentrifugation

Basic principle of Electrophoresis, Agarose gel, native and SDS-PAGE

Isoelectric focusing

SUGGESTED PRACTICALS

1. Demonstration of Ambient Air Monitoring Equipment
2. Estimation of ambient air
 - A) PM 10, PM 2.5,
 - B) SO_x, NO_x,
 - C) Ozone
3. Estimation of alkalinity and acidity
4. DO (Dissolve Oxygen)
5. COD (Chemical Oxygen Demand)
6. BOD (Biological Oxygen Demand)
7. Estimation of chloride from water and soil
8. Determination phosphorus from water and soil
9. Determination of total calcium and Magnesium water and soil
10. Determination of total organic carbon
11. Determination of total phosphorus from water and soil
12. Determination of total Nitrogen/Nitrate/Nitrite from water and soil
13. Measurement of Noise
14. Estimate the Metallic ion by Flame photometer
15. Perform PC and TLC
16. Beer-Lambert Law by Colorimetric method
17. Agarose gel electrophoresis
18. Study the biodiversity of marine organism and identification of different species.
19. Find the characteristics of Halophyte
20. Industrial field visit for the study of effluent treatment plant.

Field visit and report preparation

SUGGESTED BOOKS

1. Ecology - E.P. Odum, 1983, holt- saunders international edition
2. Environmental Science, - S.C. Santra, New central Book agency (P) Ltd
3. Environmental chemistry - A.K.De, new Age int. Pub. Co., new delhi, 1990
4. A Text book of environmental - C.S. Rao, wiley eastern limited, 1993 pollution and control
5. Water supply and sanitary engg – g.s. birdie & j.s. birdie, dhanpath raj & sons publishers, 6th edition, 1993
6. Waste water treatment – Metcalf & eddy
7. Remote sensing and GIS – m. anji reddy
8. Environmental Remote sensing – f. mark damson
9. Principles of GIS for land - burrough p.a. resources assessment
10. Microbiology - pelczar reid & chan, tata mc graw hill publishing company ltd., 1996
11. Text book of air pollution and control technologies, - y. anjaneyulu , allied publishers, 2002
12. Environmental pollution control – c.s. rao, wiley estern ltd., 1993
13. Air pollution - m.n. rao mc graw hill 1993
14. Air pollution control and engineering - de nevers, mc graw hills, 1993
15. Fundamental of air pollution - Samuel, j.w. 1971 addison Wesley publishing
16. Fundamental of environmental pollution – Krishnan khannan s. chand & company ltd., 1994
17. Environmental air analysis,- trivedi & kudesia, akashdeep pub. 1992
18. Noise pollution - vandana pandey, meerut publishrrs, 1995
19. Air pollution – by t. shivaji rao , lavanya lata pub., 1988
20. Concepts of ecology - E.J. kormondey, 1984, Indian reprint 1991 prentice hall of india .
21. Ecology & environment – P.D. Sharma, ashish publication, 1994
22. Environmental chemistry – by B.K.sharma S.H.kaur , goel publishing house meerut, 1992
23. Environmental chemistry – A.K.de., new age intl. pub co, new delhi, 1990
24. Chemistry for Environmental engineering,- C.N.sawyer and P.L.mc carty, mc kogakusha ltd., 1990
25. Introduction to ecology – paul colinvaux, 1973. Wiley international edition.
26. Fundamental of ecology – E.P. odum 1971. W.B. saunders & co.
27. Introduction to environmental toxicology -wayne G.landi ming-ho yu
28. Metod of toxicology- paget G.E.
29. Patty's industrial hygiene and toxicology – ed.by. lewis J. cralley, lester V. cralley, james S. bus
30. Text book of preventive and soil medicine - K.park
31. Renewable energy environment and development – maheswar dayal konark publishers pvt. Ltd.
32. Environmental impact assessment canter- L.W 1977 mc graw hills newyork .
33. Energy resource by - J.J mc mullan, R. morgan and R.B. murray 1983
34. Energy resource resources and option – M.N satri Himalaya publishing house ,1992
35. Energy for a sustainable world – J.goldenberg, T.B.johanson, amulya K. reddy & Robert Williams, wiley eastern ltd., 1983

36. Environmental audits, govt. industries – cahll L.B.
37. Handbook of variables of Environmental impact assessment ann arbor science 1979
38. Energy education – beena shah 1990
39. Element of biotechnology, - 1995 P.K. gupta rastogi co.
40. Industrial microbiology, -casida, wiley eastern punlishers, 1994
41. Industrial microbiology – Prescott and dunn
42. Biochemical engineering fundamental 2nd ed. By – J.E. bailey and D.F. ollis, mc grow hills 1986
43. Biotechnology – a new industrial revolution prentis S. orbis publishing ltd.,London
44. Introduction to Biotechnology – K.S. bilgram and pandey A.K. 1992 CBS pub. & distributors, delhi.
45. Environmental chemistry – moor, W.A. and moore E.A
46. Introduction to Environmental engineering and science – gilbert m. masters, prentice hall of india, 1992
47. Chemistry and the Environmental – Johnson , D.O.netterville, J.T. wood, J.C. and james, M., 1973 W.B. saunders company, Philadelphia.
48. Toxic chemical, health and the environmental, -- lave L.B. and upton, A.C. 1987. The Hopkins press ltd., London.
49. Chemistry for Environmental engineering – C.N sawyer and p l mc carty mc grow hill kogakusha ltd., 1990
50. The microbial world 1990 , stanier, p.r ingraham., wheelis, M.L. and painter, P.R. prentice-hall of india private ltd., newdelhi.
51. Microbiology – pelzar, reid and chan. Tata- mc grow hills pub., co., lit., 1996
52. Microbial physiology- metabolism - Caldwell, D.R. 1995wm c. brown publishers, inc.
53. Microbiology, davis, b.d. bulbecco , R., eisen, H.N. and ginsberg, H.S. harper and row pub.singapor 1992
54. Environmental microbiology,-- maier, R.M. pepper, I.L. and gerba, C.P. academic press,2000