Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus of the Programme
for
Post Graduate Programme
in
M. Sc. Environmental Science

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

INSTITUTE OF ENVIRONMENTAL STUDIES
FACULTY OF LIFE SCIENCE

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119

HARYANA, INDIA

for Director
Institute of Environmental Studies
Kurukshetra University
Kurukshetra-136119

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Core Course (CC-1)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Biophysical Environment		
Course Code	M24-EVS-101		
Course Type	CC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Have in-depth knowledge of the process of origination of earth with help of various theories. CLO 2: Acquire knowledge about rocks faults, weathering and volcanism. CLO 3: Gather information about various parameters of atmosphere and meteorology and be able to predict their role in weather prediction and climate science. CLO 4: Have in-depth knowledge of the process of Atmospheric general circulation and atmospheric moisture.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Environmental Geo-science**: Origin of the Earth, Primary differentiation and formation of core, mantle, crust, magma generation, Earth's orbit, Kepler's laws of planetary motion. Structure of the Earth - the Geosphere, Atmosphere and Hydrosphere. Theory of Plate Tectonics – Wegener theory of continental drift, Holmes theory of convection in the mantle, Hess theory of sea floor spreading, Vine and Matthews theory of magnetic reversals and Glomar Challenger theory of age of oceanic floors.	15
II	Geomorphological Processes: Formations and classification of rocks rock cycle, Fold, and Fault, Major types of fold and faults. Weathering and their types, Mass wasting and its types Volcanism , types, volcanic materials , process and effects of volcanism. Transport and deposition of earth's material by running water, wind, glaciers. Thermal, magnetic and gravitational fields of earth. Soil profile, soil classification, soils of India.	15

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III	Atmosphere: Composition and structure; heat budget, lapse rate , thermal inversion and mixing height; cloud formation, winds, coriolis force; waves and currents; ocean circulation and global pressure belt system, El nino, La nina and monsoons, Applied aspects of meteorology: weather and climate, spatial scales (micro, meso, synoptic and global scales), wind roses.	15
IV	**Weather and Climate**: Energy balance in atmosphere, greenhouse effect, Atmospheric general circulation. Atmospheric moisture: Forms of cloud condensation; Precipitation, Thunderstorms, floods and droughts. Global Climate variability and climate change. Introduction to weather forecasting models.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and Keller E.A (2004). *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
2. Robert E. Ricklefs (2001). *The Ecology of Nature*. Fifth Edition, W.H. Freeman and Company.
3. Bennett, M. R. and Doyle, P. (1997). Environmental Geology: - Geology and the Human Environment. John Wiley and Sons.
4. Steffen, W., Sanderson, A., Tyson, P.D., Jager, J., Matson, P.M., Moore, III, B., Oldfield, F., Richardson, K., Schnellnhuber, H.J., Turner, II, B.L. and Wasson. R.J (2004). *Global change and the Earth System: A Planet under Pressure*. Springer-Verlag, New York, New York, USA Reference books.
5. Keller, E.A. (2007). *Introduction to Environmental Geology*. 4th ed. Prentice Hall of India.

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Core Course (CC-2)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Environmental and Green Chemistry		
Course Code	M24- EVS-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Develop understanding on the concept of minerals, soil composition, properties and chemistry. CLO 2: Understand about composition and reactions in atmosphere, greenhouse gases and global warming. CLO 3: Obtain knowledge about water structure, composition, standards and aquatic chemistry. CLO 4: Know about the use of different biocatalysts as environmentally friendly reagents and industrial applications of green chemistry.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Lithosphere and Soil chemistry: Chemical composition of the earth, origin of mineral deposits and fossil fuels, major rock forming minerals, elements and isotopes. Interaction between atmosphere, hydrosphere and lithosphere. Soil Profiles, chemical and mineralogical composition of soils; soil organic matter, soil nutrients; soil properties of fundamental importance in soil management.	15
II	Atmospheric Chemistry: Chemical composition of atmosphere-atmospheric water and CO_2; ions and radicals in atmosphere, formation of particulate matter, Photo-chemical and chemical reactions in the atmosphere, thermal inversion, particles in atmosphere; photochemical smog, acid rain, chemistry of ozone layer depletion; greenhouse gases and global warming.	15
III	Aquatic Chemistry: Structure and properties of water; water quality	15

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	parameters, chemistry of inland water bodies- lakes, streams, rivers estuaries and wetlands, solubility of gases in water, carbonate system in water, redox reaction (oxidation-reduction); aquatic microbial chemistry-a brief account.	
IV	Green Chemistry: Definition, fundamental principles and tools. Catalysis for Green Chemistry: Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Enzyme-Catalyzed Hydrolytic Process, Goals of Green Chemistry- Significance and basic components of green chemistry in research - industrial applications of green chemistry. Products from natural materials- Green fuels and E-Green propellants- Zeolites- Biocatalysts.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and Keller E.A (2004). *Environment Science: Earth as a Living Plant.* John Wiley & Sons Inc., New York.
2. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York
3. Mitsch, W.J. and Jorgensen, S.E. (eds.) (1989). *Ecological Engineering: An Introduction to Ecotechnology*. John Wiley and Sons, New York.
4. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). *Soils and Environmental Quality*. Second Edition. CRC press, New York.
5. Sanghi, R. and Srivastava, M. M. (Eds.). (2003). *Green Chemistry: Environment Friendly Alternatives*. Alpha Science Int'l Ltd.

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Core Course (CC-3)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Ecology and Ecosystem Dynamics		
Course Code	M24- EVS-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Students will have in-depth knowledge about biotic and abiotic factors that are related to individual, population, community and ecosystem, as well as interrelationships CLO 2: The students will understand and be able to analyze evolutionary changes and environmental adaptations. CLO 3: Students will understand the concept of different food interactions, trophic levels, energy transfer, energy flow and sedimentary cycles. CLO 4: Student will analyze the importance of various ecosystems such as territorial ecosystems, freshwater ecosystems, ocean ecosystems and wetlands.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction : Aims and scope of ecology, biological levels of organization-genes biosphere; tolerance range and limiting factors, adaptations, ecotypes and ecads. Population ecology: Characteristics, evolutionary strategies r and k selection; population growth and regulation, Species Interactions: Competition, mutualism, parasitism, predator-prey relations, allelopathy, behavioural ecology-a brief accou	15
II	Community structure and Organization: nature of community, life-forms, vertical and horizontal stratification; functional role and niche, keystone species, ecotone and edge-effect; plant-animal interaction. Ecological Succession –concept, primary and secondary succession; concept of climax and types of climax; changes in ecosystem properties	15

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	during succession.	
III	The Ecosystem concept, biotic and abiotic components; ecosystem processes-photosynthesis and decomposition; ecological pyramids, food webs, trophic levels, energy transfer, ecological efficiencies, models of energy flow. Biogeochemical cycles, gaseous and sedimentary cycles-carbon cycle, nitrogen cycle, sulphur cycle and phosphorus cycle, Man's impact on nutrient cycles.	15
IV	Biome and aquatic systems- distribution, characteristics, climate and biota. Distinguishing characters of forests, grasslands, and arid lands. A brief account of lakes and wetlands, and coral reefs. Natural and anthropogenic disturbances, Invasive species: ecology, impacts and control.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Brewer, R. (1994). The Science of Ecology, Sanders College Publishing Co., Tokyo.
2. Lieth, H. and Whittaker, R.H. (Eds). (1975). *Primary Productivity of the Biosphere.* Springer-Verlag, New York.
3. Odum, E.P and Barrett, G.W. (2004). Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole, Belmont, California.
4. Odum, E.P. (1983). *Basic Ecology*, W.B. Saunders, Philadelphia.
5. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation,* S. Chand Publishing, New Delhi.
6. Jakhar, S. (2024). *Fundamentals of Ecology*. Techsar Pvt. Ltd., New Delhi.
7. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York.
8. Townsend, C.R., Begon, M. and Harper, J.L. (2003). *Essentials of Ecology.* Second Edition. Blackwell Publishing, Oxford.

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Core Course (CC-4)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Environmental Modeling and Statistics		
Course Code	M24- EVS-104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand the idea, methodology and basic tools of environmental modeling, their scope, limitations and applications. CLO 2: Gain knowledge about different analytical models and their applications in Ecological studies. CLO 3: Describe how basic statistical methods can be used to analyze environmental data. CLO 4: Gain knowledge about experimental designs and computer graphics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Concept of models and ecosystem modeling; model classification- deterministic models, stochastic models steady state models dynamic models. Different stages involved in model building. Ecosystem stability, Cybernetics and ecosystem regulation. Ecoinformatics- A brief account and scope in environmental analysis.	15
II	Elementary aspects of System Analysis: Systems theory, ecological models- characteristics and applications, compartment model, matrix model, statistical model, mathematical model, energy circuit analog model. Box model, Gaussian plume model. Analytical models in Ecology: logistic model of population growth; Hardy- Weinberg model; Lotka - Volterra model of competition and predation; models of succession.	15
III	Statistics- Measures of central tendency – Mean, Median, Mode, Geometric Mean and Harmonic Mean, measures of dispersion, moments, standard deviation, variance skewness and kurtosis Basic laws of probability, definition of a random variable and concept of a probability density function; binominal,	15

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	poison and normal distributions.	
IV	Principles of experimental design-randomization; replication and local control, randomized block design; application of one-way and two-way analysis of variable. Correlation and linear regression of one independent variable. A basic idea of computer graphics, use of different software; information retrieval and data management.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Gomez, K.A. and Gomes, A.A. (1984). Statistical Procedures for Agricultural Research, John Wiley and Sons, New York.
2. Gupta S.C. (1981). Fundamentals of Statistics, Himalaya Publishing House, Mumbai.
3. Hoshmand, A.R. (1998). Statistical Methods for Environmental and Agricultural Sciences, CRP Press, New York.
4. John, W. and Mark, M. (Eds). (2004). Environmental Modeling: Finding Simplicity in Complexity, John Wiley and Sons Inc., New York.

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Practicum Course PC- 1

Session: 2024-25			
Part A–Introduction			
Name of the Programme	M.Sc. Environment Science		
Semester	Ist Semester		
Name of the Course	Practical-I		
Course Code	M24- EVS-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Provide students with a comprehensive understanding of the principles, techniques, and applications of soil and water analysis CLO 2: Describe the significance of hardness in water quality and its impact on domestic, industrial, and agricultural use. CLO 3: Develop accuracy in executing standard operating procedures for soil analysis and to evaluate soil biological activity and health. CLO 4: Develop the ability to critically analyse experimental data and draw meaningful conclusions for domestic, industrial and agricultural use.		
Credits	**Theory**	**Practical**	**Total**
1	0	**4**	**4**
Teaching Hours per week	0	**8**	**8**
Internal Assessment Marks	0	**30**	**30**
End-Term Exam Marks	0	**70**	**70**
Max. Marks	0	**100**	**100**
Examination Time	0	6 hours	

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Part B-Contents of the Course	
Practicals	**Contact Hours**
1. To estimate the total hardness and temporary hardness of water. 2. To estimate total Ca and Mg content from given water samples. 3. To determine the organic carbon content in a given soil sample. 4. To determine the CO_2 evolution rate from a given soil sample. 5. To separate the soil aggregates from the given soil sample. 6. To determine the height of a particular point on a cliff with the help of a Brunton compass. 7. To determine the maximum water-holding capacity of a given soil sample. 8. To find out the pH of water and different soil samples. 9. To estimate the electrical conductivity of given soil and water solutions. 10. To estimate alkalinity in water samples. 11. To study the geological time scale 12. To study different types of maps (Climate, Geological, Agriculture crops) 13. Draw the wind roses from the given data and conclude the results. 14. To determine the soil texture with the help of the Soil Texture Triangle. 15. To determine available nitrogen in given soil sample by Kjeldhal method. 16. To determine free CO_2 in different water samples.	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Rice, E. W., Bridgewater, L. and American Public Health Association (Eds.). (2012). *Standard methods for the examination of water and wastewater* (Vol. 10). Washington, DC: American Public Health Association.
2. Bartram, J. and Ballance, R. (1996). *Water quality monitoring: a practical guide to the design and implementation of freshwater quality studies and monitoring programmes*. CRC Press.
3. Jones, J. (2018). *Soil analysis handbook of reference methods*. CRC press.
4. Carter, M.R. and Gregorich, E.G. (2007). *Soil sampling and methods of analysis*. CRC press.
5. Boyd, C. E. (2019). *Water quality: an introduction*. Springer Nature.

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Practicum Course (PC-2)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Practical-II		
Course Code	M24-EVS-106		
CourseType	PC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Collect and interpret data related to ecological fieldwork using quadrat and transect methods. CLO 2: Apply statistical tools (Pearson's correlation, regression analysis, variance, standard deviation) to ecological data. CLO 3: Estimate chlorophyll content and analyzing leaf anatomy between C3 and C4 plants. CLO 4: Interpret ecological models, such as the logistic growth curve, nitrogen cycle compartment model, and box model for pollutant concentration.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	6 hours	

Part B-Contents of the Course

Practicals	Contact Hours
1. To estimate the chlorophyll content of C3 and C4 plants. 2. To determine the frequency distribution of plants in a patch of vegetation by quadrat method. 3. To study frequency, density, basal areas of plants by using line transect method. 4. To calculate the IVI of vegetation of a given area. 5. To calculate the Simpson index of plant diversity and to draw the dominance diversity curve. 6. To compare anatomy of C3 and C4 leaves. 7. To study invasive species in a given area. 8. To find a correlation between two sets of data by using Karl's pearson method. 9. To apply regression analysis on the given data.	120

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10. To prepare logistic growth curve for a hypothetical population. 11. To calculate the measures of central tendency from given set of data by using excel software. 12. To calculate SD variance and coefficient of variation from given set of data by using excel software. 13. To prepare compartment model of N_2 cycle in grassland ecosystem. 14. To prepare the flow diagram of century model. 15. To estimate pollutant concentration over an area by box model concept.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1 Magurran, A. E. (2004). *Measuring Biological Diversity*. Blackwell Publishing.
2 Molles, M. C. (2015). *Ecology: Concepts and Applications*. McGraw-Hill Education.
3 Zar, J. H. (2010). *Biostatistical Analysis* (5th ed.). Pearson.
4 Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant Physiology and Development* (6th ed.). Sinauer Associates.
5 Southwood, T. R., & Henderson, P. A. (2000). *Ecological Methods* (3rd ed.). Wiley-Blackwell.

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Seminar

Session: 2024-25	
Name of the Programme	M.Sc. Environmental Science
Semester	Ist Semester
Name of the Course	Seminar
Course Code	M24- EVS-107
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Demonstrate a sound technical knowledge of the seminar topic. CLO 2: Improves his/her presentation skills and develop confidence.
Credits	Seminar 2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination.	

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Core Course (CC-5)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Natural Resource Management		
Course Code	M24- EVS-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Acquire knowledge about water and land resources and their conservation and management. CLO 2: Become familiar with various energy and mineral resources and their environmental impacts. CLO 3: Obtain knowledge about forest and marine resources, rangelands and deforestation. CLO 4: Develop understanding about economic categories of resources, theories and economically sustainable management of resources.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Resources: Types, Renewable & non-renewable resources; resource degradation a conservation; Human impact on natural resources. Land resources: Land degradation and desertification; Soil erosion and control; reclamation & management of waste lands with special reference to India. Water resources: Pools of water and hydrological cycle; Surface water, ground w Human use of freshwater. Rain water harvesting; watershed management	15
II	Energy resources: Renewable & non-renewable. Fossil fuels, hydropower nuclear energy, solar energy, wind energy. Energy from biomass. Mineral resources: Origin, types, exploration and production, conservation and recycling, bacterial leaching of metals from low grade ores. Environmental issues related with mineral extraction and processing.	15

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III	Forest resources: Forests, their importance, types, global distribution; primary and secondary products, forest resources of India. Impact of deforestation; Sustainable forest Management. Range lands: Types, uses, grassland types and management in India. Medicinal plant resources and bioprospecting-a brief account. Fisheries and Marine resources- a general account; aquaculture	15
IV	Economics, environment and development: Economic categories of resources; the market, environment and natural resources; the economics theory- market, demand and supply relationships. The limit of growth; cost benefit ratio; natural resources accounting; market based mechanisms for environmental protection. Economically sustainable forest management designs- green certification, resource conservation, community forest management; ecotourism. Economic efficient model of sustainable fisheries; designs for renewable energy resources.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Brown, L. (2001). *State of the World 2001.* World watch Institute in association with Earthscan, London.
2. Chape, S., Fish, L., Fox, P. and Spalding, M. (2003). *United Nations list of protected areas.* IUCN/UNEP/World Conservation Monitoring Centre, Gland, Switzerland/Cambridge
3. Cunningham, W.P. and Cunningham, M.A. (2002*). Environmental Science: Inquiry and Applications.* A Global Concern. Tata McGraw-Hill Publishing Company, New Delhi.
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation,* S. Chand Publishing, New Delhi.

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Core Course (CC-6)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Conservation and Biodiversity		
Course Code	M24- EVS-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Become familiar with principles of conservation biology and acquire knowledge about levels of biodiversity. CLO 2: Build an understanding about biodiversity patterns, biodiversity of mangroves, wetlands and coral reefs. CLO 3: Gain knowledge about biodiversity uses, services and threats to biodiversity (aquatic and marine). CLO 4: Become familiar with the various biodiversity conservation strategies and approaches.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B - Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Principles and importance of conservation biology; genetic variations, r selection, genetic drift and gene flow, minimum viable populations, genetic swam Biodiversity, magnitude, global accumulation; levels biodiversity- species, genet ecosystem diversity; species diversity indices, rank abundance patterns.	15
II	Biodiversity gradient – latitudinal and altitudinal, regional patterns of biodiversity; factors affecting biodiversity patterns; Biodiversity and ecosystem functioning; Terrestrial and marine hotspot of biodiversity. Biodiversity of mangroves, wetlands and coral reefs – A general account.	15
III	Biodiversity uses and ecosystem services; threats to biodiversity- habitat loss, habitat fragmentation, exotic species and environmental pollution; species extinction ; IUCN threat categories- global and national status; Threats to aquatic and marine biodiversity. Endangered and threatened species of India; Biodiversity assessment and	15

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	monitoring.	
IV	In situ Biodiversity conservation strategies and approaches: Protected areas, biosphere resource, protected areas in India – Sanctuaries, national parks and biosphere resources. Ex Situ Biodiversity conservation: Species management plans, captive breeding, field gene banks, seed gene banks, cryopreservation, gene banks. National and international efforts for biodiversity conservation- CITES, Ramsar Convention, Convention on biological diversity, IPR and Patent rights.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Chandel, K.P.S., Shukla, G. and Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India Conservation and Utilization, National Bureau of Plant Genetic Resources, New Delhi.
2. Heywood, V. (ed.) (1995). Global Biodiversity Assessment. United Nations Environment Programme, Cambridge University Press, Cambridge, U.K.
3. Huston, M.A. (1994). *Biological Diversity: The Coexistence of Species on Changing Landscapes*. Cambridge University Press, Cambridge.
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation*, S. Chand Publishing, New Delhi.
5. Soule, M.E. (ed.) (1986): Conservation Biology. The Science of Scarcity and Diversity. Sinaur Associates, Inc., Sunderland, Massachusetts.

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Core Course (CC-7)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Environmental Pollution		
Course Code	M24- EVS-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Identify and quantify the magnitude and intensity of ambient air pollution. CLO 2: Understand the sources, effects and control of indoor air pollution. CLO 3: Assess the causes and sources of water and soil pollution and to treat them. CLO 4: Understand the sources and effects fate of noise and radioactive pollutants.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Pollution: Definition and Types. Pollutants and contaminants: Definition, Primary and secondary pollutants, point source and non-point source pollutants. Air Pollution: definition, sources of ambient air pollution, major ambient air pollutants, criteria pollutants, Trans boundary pollution, air quality index, the effects of air pollution, measurements of pollutants, air pollution control technologies. Air quality standards.	15
II	Indoor Air Pollution: Types, Causes and Effects, Indoor Combustion, Biological Pollutants, Radon, Carbon monoxide, Asbestos, Formaldehyde. Control Measures for indoor air pollution, sick-building syndrome and building related illness.	15
III	Water pollution: Causes and effects of surface water, groundwater, marine water and thermal pollution. Control measures of water pollution. Case studies. Water quality guidelines. Soil pollution: Causes and effects. Behavior and fate of soil pollutants Remedial measures of soil pollution. Self cleaning ability of soil environment.	15
IV	Noise pollution-Sources and measurement indices of noise pollution,	15

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	Noise exposure level and standards, Noise control and abatement measures, Impact of noise on human health, Mitigation of noise Pollution. Radioactive pollution: Sources, effects and control.	
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Mirsal, IA. (2008). Soil Pollution Origin, Monitoring & Remediation, Springer-Verlag Berlin Heidelberg.
2. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York
3. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). *Soils and Environmental Quality*. Second Edition. CRC press, New York.
4. Botkin, D.B. and E.A. Keller (2004). *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
5. Miller Jr., G.T. (1997). *Environmental Science: Working With the Earth*. Wadsworth Publishing Company, Belmont, California

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Core Course (CC-8)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Environmental Methods and Analytical Techniques		
Course Code	M24- EVS-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Learn characters of vegetation and measurement of biodiversity with different methods. CLO 2: Use microbiology knowledge and skills to analyze environmental problems involving microbes. CLO 3: Demonstrate a broad and coherent knowledge and understanding of analytical chemistry and instrumental methods of analysis (photometry, spectrophotometry, chromatography). CLO 4: Use spectroscopic techniques to analyze various pollutants in environment and understand theory and techniques for their measurements of pollutants.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Analytic and synthetic characters of vegetation, methods of vegetation analysis; Species diversity and measurement of diversity; primary and secondary production, methods of measuring primary productivity; techniques for quantifying nitrogen fixation; estimation of ecosystem nutrient budget. Germ plasm evaluation and conservation- survey, inventorization, and analysis.	15
II	Techniques in environmental microbiology and its applications. Methods of analyzing soil microbial populations and diversity Measurement of microbial activity in environmental samples: microbial biomass, nitrogen mineralization soil respiration, microbial respiration and enzymatic activities. Assessment and characterization of arbuscular mycorrhizal fungal	15

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	the soil-plant system.	
III	Instrumentation Principles and applications of Spectrophotometry (UV-Visible spectrophotometry, flame photometry, Atomic Absorption spectrophotometry); Chromatographic techniques (Paper chromatography, thin layer chromatography, Gas liquid chromatography, High pressure liquid chromatography, Ion exchange chromatography, Column chromatography), Fluorometry, X-ray diffraction.	15
IV	Analytical Techniques: Air, Water and Soil samples. Sampling and analysis of air pollutants. Chemical and bacteriological sampling and analysis, water quality parameters, criteria and standards. Soil analysis - sample preparation and chemical methods of soil analysis. Vocational prospects in field of environmental analysis and research.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Chapin, F.S., Matson, P.A. and Mooney, H.A. (2002). *Principles of Terrestrial Ecosystem Ecology*. Springer-Verlag, New York
2. Clark, R.N. (1999). *Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy*. U.S. Geological Survey, Denver
3. John Wainwright and Mark Mulligan (Eds). (2004). *Environmental Modeling: Finding Simplicity in Complexity*. John Wiley & Sons Inc., New York.
4. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York

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Practicum Course (PC-3)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Practical-III		
Course Code	M24-EVS-205		
CourseType	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes(CLO) After completing this course, the learner will be able to:	1. Plot a standard graph or calibration curve and determine protein concentration from any sample. 2. Determine species diversity indices from the given community data. 3. Estimate Acid, Detergent, Fiber content from the given plant material and oil content from given seed sample. 4. Plot the water budget of the earth, groundwater system, sedimentary basin, and soil types of India.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

Practical's	Contact Hours
1. To determine the oil content from various oil yielding plants by using Soxhlet extractor apparatus. 2. To draw the calibrations curve of Bovine Serum Albumin with protein binding dye (Brad ford method). 3. To determine the Acid Detergent Fiber (ADF) content from the given plant material. 4. To determine the Simpson Dominance - Diversity Index from a given set of community data. 5. To determine α, β and γ biodiversity from the given set of community data. 6. To determine Shanon Weiner's diversity index from a given community data set. 7. Visit the Herbal Garden (List of Medicinal Plants). 8. Discuss and plot the water budget of earth in Pi-Diagram 9. Plot groundwater system in a block diagram and show confined aquifer, unconfined aquifer and artesian condition of a well.	120

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10. To study various designs of rooftop water harvesting systems. 11. Divide world into different natural regions and note their characteristic of climate, soil vegetation flora and fauna. 12. To study the physiographic, soil type, vegetation of India. 13. Plot sedimentary basin map of India and delineate different petroliferous basins. 14. To study the Moho's scale of hardness. 15. To study the physical properties of some important minerals.	

SuggestedEvaluationMethods

InternalAssessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Magurran, A. E. (2004). *Measuring Biological Diversity*. Blackwell Publishing.
2. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation*. S. Chand Publishing, New Delhi.
3. Aery, N. C. (2010). *Manual of environmental analysis*. Ane Books Pvt Ltd.
4. Mitchell, B. (2013). *Resource and environmental management*. Routledge.
5. Jain, S. K. and Singh, V. P. (2023). *Water resources systems planning and management*. Elsevier.

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Practicum Course (PC-4)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	2nd semester		
Name of the Course	Practical-IV		
Course Code	M24- EVS-206		
CourseType	PC		
Level of the course	400-499		
Pre-requisite for the course (if any)	-----		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the principles of microbiological techniques and methods (serial dilution and agar plating method) and assess soil microbial diversity and population diversity. 2. Evaluate the forest and grassland productivity and ecological significance of agroforestry systems. 3. Estimate physio-chemical properties of water samples; assess water quality and suitability to various uses. 4. To analyze particulate matter and different gases in the ambient air.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

Practicals	Contact Hours
1. To compute the Mean Annual Increment (MAI) and Annual Increment (AI) in a forestry plant area for given set of data 2. To analyse above ground and below ground productivity of an agroforestry system on the basis Dbh . 3. To determine the total plant biomass of a grass land system by harvest method. 4. To determine the dissolved oxygen (DO) content in a given water sample by WINKLER's Method. 5. To determine the carbonate and bicarbonate content from the given water sample. 6. To determine chemical oxygen demand (COD) of a given wastewater sample 7. To isolate and enumerate micro-organisms from soil by serial dilution agar plating method. 8. To isolate Vesicular Arbuscular Mycorrhizal (VAM) spores from the soil. 9. To measure the concentration of particulate matter PM2.5 using High-volume sampler. 10. To measure the concentration of particulate matter PM10 using High-volume sampler. 11.To Measure the concentration of Carbon Monoxide (CO) Using Non-Dispersive	120

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Infrared (NDIR) instrument. 12. To measure concentration of NO_2 concentration using the Jacobs & Hochheiser method. 13. To determine the concentration of SO_2 using modified West and Geake method. 14. To prepare basic solid media and to study microflora of indoor and outdoor air. 15. To perform Lactophenol blue staining of fungi isolated from air. 16. To determine λmax of the given chemical compound using spectrophotometer.	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Hurst, C. J., Crawford, R. L., Garland, J. L. and Lipson, D. A. (Eds.). (2007). *Manual of environmental microbiology*. American Society for Microbiology Press.
2. Pansu, M. (2006). *Handbook of soil analysis*. Springer.
3. Paul, E., & Frey, S. (Eds.). (2023). *Soil microbiology, ecology and biochemistry*. Elsevier.
4. Pavia, D. L., Lampman, G. M., Kriz, G. S. and Vyvyan, J. R. (2015). *Introduction to spectroscopy*.
5. Rice, E. W., Bridgewater, L. and American Public Health Association (Eds.). (2012). *Standard methods for the examination of water and wastewater* (Vol. 10). Washington, DC: American public health association.
6. West, P. W. and West, P. W. (2009). *Tree and forest measurement* (Vol. 20). Berlin: Springer.

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