KURUKSHETRA UNIVERSITY
KURUKSHETRA

("A^{++}" Grade Accredited by NAAC)

Syllabus for

Under-Graduate Programme

(Subject: Environmental Science)

(5th to 8th Semester)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2024-25 (in phased manner)

Session: 2024-2025			
Part A - Introduction			
Subject	**Environmental Science**		
Semester	SEMESTER-5		
Name of the Course	**Environmental Biotechnology**		
Course Code	B23-EVS-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Understand the fundamental concepts of environmental biotechnology and explore its role in environment conservation. 2. Understand the production of transgenic plants and the bioethical considerations associated with them. 3. To acquire knowledge about modern fuels and the role of microorganisms in the enrichment of ores. 4. Apply the knowledge to real-world challenges in environment management. 5. To have practical knowledge about the plant tissue culture and the working of different instruments.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20+ Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)	**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours		
Part B - Contents of the Course			

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Fundamentals of Environmental Biotechnology: Scope and importance, modalities and local influences; Integrated approach in environmental biotechnology.	12
II	Transgenic plants: Production, Micropropagation; Types of GM Plants and their products, Biopharming, Safety of transgenic crops; Bioethics: Definition and importance of ethics in biology.	11
III	Biotechnology & modern fuels, their environmental impact. Bioremediation-in situ and ex-situ methods. Role of microorganisms in ore-enrichment.	11
IV	Biotechnology in Waste Management: Phytoremediation. Treatment of municipal waste and Industrial effluents: Biological processes, Activated Sludge Process; Bio-fertilizers.	11
V	**Practical's** 1. To study about the principles and applications of instruments used in Environmental laboratory. 2. To study about the steps of micro- propagation. 3. Qualitative estimation of Carbohydrates and Proteins in the given sample. 4. Qualitative estimation of Amino acids and Fats and oils in the given sample. 5. Hands-on training on spectrophotometer.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1. Environmental Biotechnology (2007) Bimal Bhattachraya and Ritu Banerjee, Oxford university press
2. Environmental Biotechnology Concept and application (2004) 1st edition, edited by Hans-Joachim Jördening and Josef Winter. Wiley VCH Verlag GmbH & Co. KGaA.
3. Handbook of Methods in Environmental Studies: Vol 1: Water and Wastewater Analysis(2001) S. K. Maiti. ABD Publishers.
4. Environmental Biotechnology (2013) Pradipta Kumar Mohapatra I.K. International Publishing House Pvt. Limited

MCC-10

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-5		
Name of the Course	**Water Resource and Management**		
Course Code	**B23-EVS-502**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**MCC**		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To have knowledge about the properties and importance of water. 2. To acquire knowledge of water resources in India. 3. To understand water quality parameters and water treatment. 4. To describes various water conservation and management practices 5. To apply the knowledge after studying various theoretical aspects of water resource management in investigating the water quality parameters, water treatment methods, water conservation methods and resolving present day issues of water scarcity and pollution.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1			

(objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Introduction to water: Structure of water, unique properties of the water, importance and uses of water, distribution of Earth's water, hydrological cycle.	12
II	Water resources in India: precipitation, glaciers, oceans, estuaries, rivers, lakes and wetlands, mangroves, manmade reservoirs and dams, and groundwater.	11
III	Physical, chemical, and biological parameters of water quality. Water quality standards. Wastewater treatment.	11
IV	Water conservation and management practices. Rainwater harvesting: traditional and modern methods. Watershed management, cloud seeding, drip and sprinkler irrigation method, desalinization.	11
V	**Practical's** 1. To map major dams in India. 2. To analyze calcium and sodium content in water. 3. To estimate fluoride content in water. 4. To estimate DO in water. 5. To study the working of a water treatment plant and to calculate its efficiency by using data.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi.
2. Manahan, S.E. (2000). Environmental Chemistry. 7th Edition. Lewis Publishers, New York.
3. Patnaik, P. (2017). Handbook of Environmental Analysis.CRC Press.
4. Perspectives in Environmental Studies (2002). 7th Edition. New Age International Publishers. New Delhi.
5. Sharma, H. R. (2018). Water-General Introduction. Module prepared for ePG Pathshala (a MHRD Project) for Environmental Sciences subject, paper Water Resources and Management, Module ID: EVS/WRM-V/1, pp: 16, 2018. Available at: http://epgp.inflibnet.ac.in/view_s.php?category=275
6. Sharma, H. R. (2018). Water Resources of India. Module prepared for ePG Pathshala (a MHRD Project) for Environmental Sciences subject, paper Water Resources and Management, Module ID: EVS/WRM-V/2, pp: 20, 2018. Available at: http://epgp.inflibnet.ac.in/view_s.php?category=275

DSE-2

Session: 2024-2025			
Part A – Introduction			
Subject	Environmental Studies		
Semester	SEMESTER-5		
Name of the Course	**Agroforestry And Agroecology**		
Course Code	B23-EVS-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know about the scope of global and national needs for Agroforestry with its practices. 2. to equip students with advanced knowledge and techniques for effective plant management strategies 3. Understand the principle of Agroecology and its role in ecological agriculture. 4. to provide practical knowledge and applications of agroecological principles		
	5. To gain practical experience in agroforestry systems, soil analysis, biodiversity monitoring, and documentation of traditional agroecological practices		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 **Internal Assessment Marks**: 30 (Theory 20 +Practical 10) **End Term Exam Marks**: 70 (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B- Contents of the Course

Instructions for Paper-Setter

For the final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Agroforestry: Concept, Definition, Benefits and Limitations, An overview: Shifting cultivation, Taungya cultivation, shelterbelts and windbreaks, energy plantation and homestead gardens.	12
II	Advanced Agroforestry Practices: Plant management strategies. Tree-crop interactions, Allelopathy and its implications, Integration of organic farming principles.	11
III	Fundamentals of Agroecology: Principles, Concepts, Structure and Functions, Sustainable agriculture practices	11
IV	Applied Agroecology: Ecological Pest Management, Water Management in Agroecosystems, Social Dimensions of Agroecology, Role in food sovereignty.	11
V	**Practical's** 1. Visit and collect information on various trees and crops near agroforestry. 2. Collection and processing of soil samples for physicochemical parameters analysis. 3. To monitor and document biodiversity (flora and fauna) in a selected agroecosystem over time. 4. To compare crop productivity between organic and conventional farming systems. 5. To document and understand traditional agroecological practices followed by local farmers through field surveys	30

Suggested Evaluation Methods

Internal Assessment:	End Term Examination:
➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practical** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	Theory: 50 marks (Written exam) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc.)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi.
2. Méndez, V. E., Bacon, C. M., Cohen, R., & Gliessman, S. R. (Eds.). (2015). Agroecology: A transdisciplinary, participatory and action-oriented approach. CRC press.
3. Newton, Paul C.D., Carran R.A., Edwards, G.R. and Niklaus, P.A. (2007). Agroecosystems in a Changing Climate. Advances in Agroecology Vol.12 CRC/Taylor & Francis.
4. Kumar, B.M. and Nair P.K.R. (eds.) (2006). Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Series, Advances in Agroforestry, Vol. 3. Kluwer Academic Publishers, Dordrecht, the Netherlands.
5. Nair, P.K.R. 1989. Agroforestry Systems in the Tropics, Kluwer, Netherlands.
6. Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, the Netherlands.
7. Gliessman, S. R. 2002. Agroecosystem Sustainability: Developing Practical Strategies. CRC Press
8. Lynggaard, K. 2006. The Common Agricultural Policy and Organic Farming: An Institutional Perspective on Continuity & Change. CAB International.

DSE-2

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-5		
Name of the Course	**Ecological Restoration**		
Course Code	**B23-EVS-504**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Understand the concepts of ecological restoration, including the history, scope, and importance of restoration efforts in environmental conservation 2. Gain practical skills in various ecological restoration techniques for both terrestrial and aquatic ecosystems. 3. Identify and analyze the socio-economic factors and emerging technologies affecting restoration practices. 4. Students will evaluate case studies of successful ecological restoration projects to understand best practices and ethical considerations 5. To Apply theoretical knowledge to practical scenarios related to ecological restoration.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B- Contents of the Course		
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.		
Unit	**Topics**	**Contact Hours/Week**
I	**Introduction to Ecological Restoration:** Definition, concepts. History and scope of restoration. Importance of ecological restoration in environmental conservation, Case studies showcasing successful ecological restoration projects.	12
II	**Ecological Principles and Processes** - Ecological succession and its relevance to restoration ecology, Biodiversity conservation and its role in restoration, Ecosystem services and their restoration implications	11
III	**Techniques and Methods in Ecological Restoration: – Terrestrial ecosystems:** Issues and challenges with Restoration of degraded agricultural soils and salt affected soils. Restoration of forest landscape. **Aquatic ecosystems**: basic concepts of Restoration of lakes & ponds. Restoration of wetlands.	11
IV	**Challenges and Future Directions in Ecological Restoration:** Tools of restoration. Socio-economic factors influencing restoration efforts, Indigenous knowledge and community involvement in restoration projects, Emerging technologies and innovations in ecological restoration**.**	11
V	**Practical's** 1. Soil sampling and analysis for soil health indicators such as pH, nutrient levels, and organic matter content of degraded sites 2. Case study of Sukhomajri watershed management project. 3. Identify the parameters to be declared a land as salt-affected land 4. To study the degraded site and make a report suggesting mitigation measures. 5. Case study of ecological restoration of Yamuna biodiversity park, Delhi.	30
Suggested Evaluation Methods		

Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Kay, J. J., & Bishop, J. G. (Year). Principles of Ecological Restoration. Publisher.
2. Falk, D. A., Palmer, M. A., & Zedler, J. B. (Year). Foundations of Restoration Ecology. Publisher.
3. Apfelbaum, S. I., & Haney, A. (Year). Restoring Ecological Health to Your Land. Publisher

DSE-3

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-5		
Name of the Course	**Biomedical and E-Waste Management**		
Course Code	**B23-EVS-505**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To acquire knowledge about biomedical wastes. 2. To enhance understanding of biomedical waste treatment. 3. To describe about the collection and disposal of e-wastes. 4. To explore different methods and technologies for e-waste reduction and recycling. 5. To apply the knowledge after studying various aspects of biomedical and e-wastes treatment and disposal and resolving present day waste issues arising out due to their improper management disposal.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight			

questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Bio-Medical Waste: sources, classification. Steps in biomedical waste management – segregation, collection, color coding of bins, storage, transfer and treatment. Health impacts of bio-medical waste. Infection prevention.	12
II	Biomedical waste treatment - autoclave, hydroclave and microwave treatment, shredding, solidification and stabilization, chemical disinfection, bioremediation. Biomedical waste disposal- secure landfilling and incineration. The Bio-Medical Waste Management Rules, 2016.	11
III	E-waste: composition, generation and properties. Harmful substances in e-waste; Effect on environment and human health. E-waste collection and disposal. Basic principles of E-waste management.	11
IV	Resource recovery potential of e-waste. Recycling and recovery technologies from electronic waste. Extended Producers Responsibility (EPR), Import of e-waste permissions. E-Waste (Management) Rules, 2022. Case studies of e-waste management from India.	11
V	**Practical's** 1. To study the use of different color dustbins in a nearby hospital or clinic. 2. To study the status of bio-medical waste disposal practices in a nearby hospital or clinic. 3. To study the different types of e-waste generated in your organization. 4. To study the status of e-waste disposal practices in your organization. 5. To study the Extended Producers Responsibility case study in Indian context.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. UNIDO. (2018). Training manual on bio-medical waste management for doctors, nurses, nodal officers and waste managers. Available at: https://moef.gov.in/wp-content/uploads/2019/05/4.-doctorss-manual.pdf
2. Narasimha, M., Prasad, V. et al. (2019). Handbook of Electronic Waste Management: International Best Practices and Case Studies. Butterworth-Heinemann
3. George T. G. and Kreith, F. (2002). Handbook of Solid Waste Management, 2nd Edition. The McGraw-Hill Companies, Inc.
4. Kumar, P., Reddy, K. V. K. and Mishra, S. Manual for Bio Medical Waste Management. AIIMS, New Delhi available at: https://www.aiims.edu/images/pdf/BMW-Book%20final.pdf

DSE-3

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-5		
Name of the Course	**Hazardous Waste Management**		
Course Code	**B23-EVS-506**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	1. To learn the source, types, and characteristics of hazardous wastes. 2. To learn the regulations regarding the storage and transportation of different wastes. 3. To understand the different types of treatments used in hazardous waste management. 4. To learn the different types of treatments and disposal methods of hazardous wastes and the Acts related to hazardous waste. _____ 5. To understand the source and composition of different hazardous wastes. It also helps to understand the concept of landfills and the impacts of radioactive waste through case studies.		
Credits 4	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B- Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Introduction to hazardous waste- definition, sources, properties, and types (nuclear wastes, biomedical waste, nuclear waste-lead acid batteries, electronic wastes, etc.) of hazardous waste, Fate and transport of hazardous waste in the Environment; Collection, Transportation, Treatment, Storage, and Disposal Need for hazardous waste management, Impact of hazardous waste on human health	12
II	Storage and transportation of Hazardous waste: Guidelines, Compatibility of waste, Containers, Labelling, Marking and Placarding, Surface Impoundment, Manifest System and Reporting, Modes of Transportation of Hazardous Waste.	11
III	Hazardous waste treatment (Physical and Chemical)- Physical waste treatment processes, Chemical waste treatment processes, Filtration & Separation, Chemical Precipitation, Chemical Oxidation, solidification & stabilization, Evaporation, and Ozonation.	11
IV	Hazardous waste treatment -biological waste treatment processes-Aerobic and Anaerobic treatment, Thermal waste treatment processes-Incineration, Pyrolysis, Bioremediation, Bio-reclamation, Hazardous waste disposal: Deep Well Injection, secure landfills, underground storage tank. Environmental regulation for waste management: Hazardous Waste (management and handling) Rules,2016.	11

V	**Practical's** 1. Study of source and composition of different types of hazardous waste. 2. Case study of a secure landfill site. 3. Case study of accident due to radioactive waste. 4. Prepare a report on the biomedical waste disposal method adopted in your area. 5. Prepare a report on the method used/outdated battery disposal in university.	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA		**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)
Part C-Learning Resources		
Recommended Books/e-resources/LMS: **1.** Ministry of Environment & Forest: Guidelines for Transport, Storage and Disposal of Hazardous Waste. New Delhi. **2.** Harish K. (2001) Environmental Health Hazards. Sarup& Sons, New Delhi. 8. **3.** Wentz C. A. (1995) Hazardous Waste Management, Mc. Graw – Hill Book Company, Koga. **4.** Tchobanoglous G., Theisen H. and Vigil S. (1993) Integrated Solid Waste Management: Engineering Principles and Management Issues, New York, **5.** McGraw-Hill.Basic Hazardous Waste Management, William C. Blackman.Jr, Third Edition, 2001, Lewis Publishers.		

CC-6/MCC-11

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	Basics of Remote Sensing and GIS		
Course Code	**B23-EVS-601**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To have knowledge of the basic principle of remote sensing with help of theories and understanding of the interaction of electromagnetic radiation with the matter. 2. To acquire knowledge of the various platforms for open access spatial data for scientific and other usage. 3. To understand different types of remote sensing platforms, sensors and images. 4. To have knowledge of the basic concepts of GIS, data types, components, tools and software. 5. To apply the knowledge after studying various aspects of Remote Sensing and GIS in the different areas of environmental science.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 + Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B - Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Foundations: history and scope of remote sensing; Basic principle of remote sensing. Types of satellites: Earth observation, meteorological, navigation. Remote sensing data: open access platforms. Future development.	12
II	Remote Sensing: Active and Passive Remote Sensing; remote sensing platform and sensors. Color composite models of images: RGS, IHS and YMC; Digital and analog images; Sensor resolution: spatial, spectral, radiometric, temporal and angular. Basic elements of image interpretation.	11
III	Geographical information system (GIS): introduction, roots of GIS, overview of information system. GIS data types: raster and vector. GIS architecture: components of GIS, GIS workflow. Integration of remote sensing and GIS.	11
IV	GIS data input methods. GIS data exchange, conversion and output. Aspatial component of GIS data. GIS data storage and file format. Selection operators, buffering. Geographic web services: spatial data crowd-sourcing and web storage.	11
V	**Practical** 1. Investigate different online open access platforms to use remote sensing data. 2. To investigate societal need for designing future remote sensing missions. 3. Investigate the Govt. initiated spatial data crowd-sourcing campaign as a case study. 4. Design an application-oriented conceptual GIS architecture. 5. Investigate different type of querying and selection operators.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc.)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1) Textbook of Remote Sensing and Geographical Information Systems. (2012). Anji Reddy. 4th ed., BS Publications.
2) Remote Sensing and Image Interpretation (An Indian Adaptation). (2023). Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, P. K. Champati Ray. 7th ed., Wiley.
3) Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems. (2014). Gottfried Konercny. 2nd ed., CRC Press.

MCC-12

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	WASTE MANAGEMENT		
Course Code	**B23-EVS-602**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the student will be able to: 1. To understand different types of waste and basic elements of wastes management. 2. To acquire knowledge about liquid waste treatment and disposal. 3. To describe about the treatment and disposal of biomedical, hazardous and electronic waste. 4. To explore different methods and technologies for waste disposal and reduction. 5. To apply the knowledge after studying various aspects of wastes disposal and management and resolving present day waste issues arising out due to improper waste disposal.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B- Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Types of waste: solid, liquid, biomedical, hazardous and e-waste. Classification of wastes. Functional elements of waste management system. Environmental and health impacts of improper waste disposal.	**12**
II	Liquid waste: characteristics and disposal methods- septic tanks, seepage pits, cesspools. Advance waste water treatment: ion exchange, electro-dialysis, reverse osmosis, and ultra filtration.	**11**
III	Biomedical waste: colour coding and treatment, Hazardous waste: properties, physical, chemical and biological treatment. E-waste: sources, generation, treatment and disposal. E-waste pollutants.	**11**
IV	Different methods of waste disposal: land filling, incineration, composting, vermi-composting, biogas production and deep-well injection. Reduction, reuse and recycling of wastes.	**11**
V	Practical's 1. To classify household waste of your home. 2. To study the status of awaste disposal site of your area. 3. To study the use of different color dustbins in a nearby hospital or clinic. 4. To analyze the BOD of a treated and untreated sewage water 5. To analyze the COD of a treated and untreated sewage water	**30**

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. George T. G. and Kreith, F. (2002). Handbook of Solid Waste Management, 2nd Edition. The McGraw-Hill Companies, Inc.
2. Singh J. and Ramanathan A.L. (2010). Solid Waste Management: Present and Future Challenges, International Publishing House Pvt. Ltd. New Delhi.
3. Narasimha, M., Prasad, V. et al. (2019). Handbook of Electronic Waste Management: International Best Practices and Case Studies. Butterworth-Heinemann.
4. Bhatia S.C. (2007). Solid and Hazardous Waste Management, Nice Printing Press, Delhi.
5. Kumar, P., Reddy, K. V. K. and Mishra, S. Manual for Bio Medical Waste Management. AIIMS, New Delhi available at: https://www.aiims.edu/images/pdf/BMW-Book%20final.pdf

DSE-4

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	**Environmental Legislation**		
Course Code	**B23-EVS-603**		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	1. To develop students a fundamental understanding of law. 2. To develop an understanding of the students regarding various legislation on Environmental law. 3. To develop student's fundamental understanding of international law. 4. The students will also learn about the role of important agencies and the importance of international conventions. 5. The student will get knowledge about various projects related to the conservation of wildlife, and case studies related to air pollution and the National Green Tribunal, and also be able to understand the drawbacks of environmental legislation and difficulties in its enforcement.		
Credits 4	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 +Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)	**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours

Part B- Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Introduction to Environmental Law in India: Constitutional Perspective: Relevant Provisions- 48-A, 51-A(g), fundamental rights, Human Rights and Environment, Public interest litigation, Polluter pays principle, Indian Penal Code, National Green Tribunal.	12
II	Legislation for environment protection in India: The Water (Prevention and Control of Pollution) Act, 1974 and amendments, The Air (Prevention and Control of Pollution) Act, 1981 and amendments, Central & State pollution control boards and its powers and functions- offenses and penalties, Wildlife Protection Act, 1972 and amendments, Forest (Conservation) Act, 1980 and amendments.	11
III	Introduction to International Environmental Treaties: United Nations Conference on Human Environment,1972(Stockholm Conference)-Aims and Objectives of the Conference, Rio Conference, 1992-Aims and Objectives, Johannesburg Conference 2002-Major outcomes. Role of International Environmental Agencies-UNEP (United Nations Environment Programme), UNFCC (United Nations Framework Convention on Climate Change), and IPCC (Intergovernmental Panel on Climate Change).	11
IV	International agreements on environmental issues: Conference of Parties, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); Convention on Biological Diversity (CBD), Kyoto Protocol, Montreal Protocol.	11
V	**Practical's** 1) Study different wildlife-related projects under the Wildlife Protection Act 1972. 2) Case study related to the Air (Prevention and Control of Pollution) Act, 1981. 3) Case Study of climate change under UNFCC.	30

	4) Case study under The National Green Tribunal Act, 2010. 5) Study of drawbacks in environmental legislation and difficulties in its enforcement.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sahasranaman P B, 2008 Handbook of Environmental Law in India, Oxford University Press (India).
2. Singh Gurdip, 2004, Environmental Law in India, Mcmillan & Co.
3. Shastri S C, 2008, Environmental Law, (2nd Edn.), Eastern Book Company, Lucknow
4. Vig, N.J. and Axelrod R.S. (Eds) (1999). The Global Environment: Institutions, Law and Policy. Earthscan London.
5. Divan S. and Rosencranz A. (2002). Environmental law and policy in India: cases, materials and statutes. Oxford University Press.
6. Ferrey S. (2004). Environmental Law: Examples and Explanations. Aspen Law & Business. Springer-Verlag New York, LLC.

DSE-5

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	Environmental Management System and Standards		
Course Code	**B23-EVS-604**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1.Understand the fundamental concepts of environmental management and sustainable development. 2. Assess comprehensive knowledge and skills for the effective implementation of Environmental Management Systems and benefits in resource management. 3.Familiarize with various environmental systems and standards. 4. Acquire knowledge about the standard certification process, life cycle assessment, and analysis. 5. To apply comprehensive knowledge of Environmental Management Systems, Environmental Standards, and Certification processes.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 + Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B - Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	**Basic concept of Environmental Management**: Environmental sustainability, Environmental performance indicators, environmentally responsible organization, identification and study of environmental aspects and environmental impacts, Importance of sustainable development.	12
II	**Environmental Management Systems (EMS):** origin, scope, key elements, and components of an EMS, Plan Do Check Act (PDCA) model, Environmental management systems in India.	11
III	**Environmental Standards:** ISO-Introduction, origin and functions, ISO 14001: Overview, significance Other relevant standards. Case studies of ISO in Environment management.	11
IV	**Introduction to Certification**: concept, types and procedures in India. Life Cycle Assessment and waste minimization	11
V	**Practical** 1. To evaluate recent guidelines and framework for implementation of EMS in India. 2. Visit local industries, waste treatment plants, or natural ecosystems to observe environmental management practices. 3. Study or discuss EMP of a building or facility and collect data. 4. Case studies related to the successful implementation of EMS and Environmental standards. 5. Study of ISO-14000 family standards.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc.)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1) Welford, R. (2016). Corporate environmental management 1: systems and strategies. Routledge.
2) Mitchell, B. (2013). Resource and environmental management. Routledge.
3) Edwards, A. J. (2003). ISO 14001 Environmental certification step by step: Revised Edition. Elsevier.
4) Dentch, M. P. (2016). The ISO 14001: 2015 Implementation Handbook. Quality Press.
5) Morris, A. S. (2004). ISO 14000 environmental management standards: Engineering and financial aspects. John Wiley & Sons.
6) Sheldon, C., & Yoxon, M. (2012). Environmental management systems: a step-by-step guide to implementation and maintenance. Routledge.
7) Çalıyurt, K., & Yüksel, Ü. (Eds.). (2017). Sustainability and management: An international perspective. Taylor & Francis.
8) Will, M., Brauweiler, J., & Zenker-Hoffmann, A. (2021). Environmental Management Systems According to ISO 14001. In Industry, Innovation and Infrastructure (pp. 335-353). Cham: Springer International Publishing.
9) Kulkarni, V., & Ramachandra, T. V. (2006). Environmental management. The Energy and Resources Institute (TERI).

DSE-5

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	Energy And Environment		
Course Code	**B23-EVS-605**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Understand the basic concept of energy, related principles, processes, energy efficiency, and conservation. 2. Acquire knowledge about the classification, availability, present scenario, and challenges associated with energy resources. 3. Familiarize with the problems associated with fossil fuels and related environmental issues. 4. Develop deep knowledge about energy security, global climate change, and practical approaches towards energy conservation, and encourage environmental awareness. 5. Students can understand key concepts of energy generation and its relation to the environment with the help of visits and case studies.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 + Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B - Contents of the Course		
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.		
Unit	**Topics**	**Contact Hours/Week**
I	Basics of energy: energy units, energy and power, exergy, energy bill, different forms of energy, laws of thermodynamics, ten percent law, entropy, environmental concerns, energy efficiency and conservation.	12
II	Introduction to energy sources and their classification, Conventional energy resources (coal, oil, and natural gas): availability and challenges, non-conventional energy resources: Solar, hydro, wind, advantages and limitations.	11
III	Humans and energy, Environmental consequences of fossil fuel use, pollution from energy use, atmospheric pollution. Energy security issues, energy conservation and energy-efficient buildings.	11
IV	Energy and global climate change, GHG emissions from various energy sources, Intergovernmental Panel on Climate Change (IPCC), Global environmental awareness (Earth Hour),	11
V*	**Practical** 1. Study of solar spectrum and radiation measuring instruments (Pyranometer and Pyrheliometer). 2. Study of energy security issues and policies in India. 3. Study and demonstration of bomb calorimeter. 4. Case study of thermal power plant. 5. Study of important energy reserves of India (Coal, petroleum & natural gas).	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc.)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1) Ristinen, R. A., Kraushaar, J. J., & Brack, J. T. (2022). Energy and the Environment. John Wiley & Sons.
2) Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi.
3) Wolfson, R. (2011). Energy, environment, and climate. WW Norton & Company.
4) Goldemberg, J., & Lucon, O. (2009). Energy, environment and development. Routledge.
5) Dincer, I., & Rosen, M. A. (2012). Exergy: energy, environment and sustainable development. Newness.
6) Nersesian, R. L. (2016). Energy economics: markets, history and policy. Routledge.

DSE-5

Session: 2024-2025			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-6		
Name of the Course	**Renewable & New Energy Sources**		
Course Code	B23-EVS-606		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Develop a deep understanding of current global energy scenarios and a comprehensive introduction to renewable energy sources in terms of environmental sustainability. 2. Acquire basic knowledge about the components of hydropower and wind power generation systems and their working. 3. Understand the principles and practical applications of solar and nuclear energy. 4. Learn about biomass to energy conversion and hydrogen production technologies; and their contribution to mitigate climate change. 5. Understanding the principles of energy extraction from renewable sources, and broad applications of renewable energy.		
Credits 4	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 20 + Practical 10) **End Term Exam Marks: 70** (Theory 50 + Practical 20)		**Exam Duration** **Theory:** 3 Hours **Practical:** 4 Hours	

Part B - Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Introduction of renewable energy, types and importance. Comparison of non-renewable and renewable energy resources, Present Indian and International energy scenarios.	12
II	Hydropower: working and components and environmental impacts of hydropower. Wind power: working of wind power plants, wind farms, benefits and environmental impacts.	11
III	Solar power: Solar spectrum, radiation and measuring instruments (Pyranometer and Pyrheliometer), applications. Nuclear energy: isotopes, radioactive decay, half-life, nuclear fission and fusion reaction, and nuclear reactors, implication of nuclear energy.	11
IV	Biomass resources, biomass-energy, bioenergy applications, biogas production and factors affecting biogas generation. Energy storage systems, hybrid energy systems.	11
V	**Practical** 1. Study the principle of solar photovoltaic systems and different solar energy applications. 2. Demonstration of solar water heater system. 3. Explore and visit nearby renewable energy technologies (case studies). 4. Case study of the potential of waste-to-energy conversion processes. 5. Study the process and working of a biogas plant.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks ➢ **Practicum** • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc.)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1) Kothari, D. P., Ranjan, R., & Singal, K. C. (2021). Renewable energy sources and emerging technologies.
2) Maczulak, A. E. (2010). Renewable energy: sources and methods. Infobase Publishing.
3) Gross, M., & Mautz, R. (2014). Renewable energies. Routledge.
4) Wengenmayr, R., & Bührke, T. (Eds.). (2013). Renewable energy: sustainable energy concepts for the energy change. John Wiley & Sons.
5) Rathore, N. S., & Panwar, N. L. (2007). Renewable energy sources for sustainable development. New India Publishing.
6) Ehrlich, R., Geller, H. A., & Cressman, J. R. (2022). Renewable energy: a first course. CRC press.
7) Da Rosa, A. V., & Ordóñez, J. C. (2021). Fundamentals of renewable energy processes. Academic Press.

CC-H1

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	Applications of Remote Sensing and GIS	
Course Code	**B23-EVS-701**	
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: **1.** To acquire knowledge about the application of remote sensing and GIS in land use and land cover. **2.** To acquire knowledge about the application of remote sensing and GIS in disaster management. **3.** To acquire knowledge about the application of remote sensing and GIS in meteorology, atmospheric pollutants and greenhouse gases. **4.** To get familiar with the application of remote sensing and GIS in various local, regional and national issues.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 30) **End Term Exam Marks: 70** (Theory 70)		**Exam Duration:** 3 hours

Part B - Contents of the Course		
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.		
Unit	**Topics**	**Contact Hours/Week**
I	Application in land cover (natural resource) and land age management (forest, grassland, water bodies, snow): Monitoring and mapping of resources using GIS.	15
II	Application in disaster management (flood, landslide, drought, forest fire, tsunami): disaster and post-disaster monitoring and mapping using remote sensing; and spatio-temporal analysis, modelling and forecasting using GIS.	15
III	Application in meteorology. Monitoring and mapping of pollutants and GIS using remote sensing; spatio-temporal analysis, modelling and forecasting/prediction using GIS.	15
IV	Use of remote sensing and GIS in finding solutions of the various local, regional and national issues - case study-based analysis: carbon neutral economy, urban planning, solid waste management, pollution monitoring.	15
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 10 marks • Mid-Term Exam: 15 marks		**End Term Examination:** Theory: 70 marks (Written examination)

Part C - Learning Resources
Recommended Books/e-resources/LMS: 1) Textbook of Remote Sensing and Geographical Information Systems. (2012). Anji Reddy. 4th ed., BS Publications. 2) Remote Sensing - Applications. (2012). Ed. Boris Escalante- Ramírez. 2nd ed., InTech. 3) Introduction to Remote Sensing. (2011). James B. Campbell, Randolph H. Wynne. 5th ed., Guilford Press. 4) Remote Sensing and GIS Integration - Theories, Methods and Applications. (2010). Qihao Weng, McGraw Hill.

CC-H2

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	Environmental Microbiology	
Course Code	**B23-EVS-702**	
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1) Understand the fundamental concepts of environmental microbiology and explore the interrelationship between microbiology and the environment. 2) To acquire knowledge about the role of microbes in creating environmental pollution and the diseases associated with them. 3) To acquire knowledge about the life of microbes in extreme environmental conditions and various measures to control them. 4) Understand the various applications of microbiology in environmental conservation, pollution control, and sustainability.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 30) **End Term Exam Marks: 70** (Theory 50)		**Exam Duration:** 3 hours

Part B - Contents of the Course		
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.		
Unit	**Topics**	**Contact Hours/Week**
I	Introduction to Environmental microbiology: History, Evolution, Scope and importance; Microbial Diversity, Natural habitats of microorganisms. Microorganisms as components of ecosystem-as producers and decomposers;	15
II	Microbes in air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Air sanitation; Air-borne diseases. The nature of aquatic habitats, Pollution of aquatic habitats, Water-borne diseases.	15
III	Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals: As, Cd, Pb and Hg; Microbial life in conditions of high irradiation, mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations,. Control of microorganisms.	15
IV	Environmental application: Treatment of solid wastes -composting, Vermicomposting, silage; Treatment of liquid wastes, Degradation of pesticides and detergents; synthetic polymers; xenobiotic compounds; Petroleum and hydrocarbon. GMO and their uses in environmental management	15
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 10 marks • Mid-Term Exam: 15 marks		**End Term Examination:** Theory: 70 marks (Written examination)

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. Grant W.D. and Long, P.L. (1981). Environmental Microbiology. Blackie Glasgow and London.
4. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. Inc. Publications, New York.
5. Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Waste.

CC-H3

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	**Environmental Statistics and Modeling**	
Course Code	**B23-EVS-703**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**CC**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, 1. Students will be able to understand the basic concepts of environmental statistics and its applications 2. Students will understand the basic methods of statistics and their applications 3. Students will be able to understand the basic concepts of environmental modeling 4. The students will understand different ecological models	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Exam Duration:** 3 hours
Part B- Contents of the Course		
Instructions for Paper- Setter For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.		

Unit	Topics	Contact Hours/Week
I	Introduction to Environmental Statistics: Definition, Scope and Applications in Environmental Science; Types of data, data presentation (Tables, Histograms, Pie Diagrams, Scatterplots); role of environmental statistics in decision making and ethical considerations.	15
II	Descriptive Statistics: Definition and Importance, Measures of Central Tendency (Mean, Median, Mode): calculation for grouped and ungrouped data, advantages and limitations; Measures of Dispersion (Range, Standard Deviation and Variance): definition, calculation for grouped and ungrouped data, interpretation and limitations Basic laws of probability; Correlation and simple linear Regression analysis.	15
III	Environmental Modeling: definition, key components and types of models (deterministic vs stochastic; static vs dynamic); basic concepts and terminology (systems, subsystems, boundaries, variables, parameters, constants, stocks and flows), importance and applications of environmental and ecological modeling Overview of conceptual, analytical and simulation models in ecology.	15
IV	Population growth models (logistic and exponential); Lotka Volterra models of competition and predation Energy flow models, Case studies of energy flow models in various ecosystems; box model to study air pollution.	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Gupta, S. P. (2010). Statistical Methods. E. Gayathiri publication.
2. Prasad, S. (2018). Fundamentals of Biostatistics. Rastogi Publications.
3. Antonisamy, B., Premkumar, P.S. and Christopher, S. (2017). Principles and Practice of Biostatistics. Elsevier India.
4. Hoshmand, A.R. (1998). Statistical Methods for Environmental and Agricultural Sciences, CRP Press, New York.

5. John, W. and Mark, M. (Eds). (2004). Environmental Modeling: Finding Simplicity in
6. Complexity, John Wiley and Sons Inc., New York.
7. Jorgensen, S.E. (2011). Fundamentals of Ecological Modelling: Applications in Environmental Management and Research. Elsevier

8. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications.

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	**Occupational Health and Safety**	
Course Code	**B23-EVS-704**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE-H1**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To understand the occupational health and safety approach. 2. To evaluate the workplace to determine the existence of occupational safety and health hazards and their possible causes. 3. To acquire knowledge about the indicators of different risks and accidents in occupations. **4.** 4. To learn the methods for prevention and protection from occupational hazards.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End-Term Exam Marks: 70**		**Exam Duration:** 3 hours
Part B- Contents of the Course		

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal

marks

Unit	Topics	Contact Hours/Week
I	**Introduction to occupational health and safety:** Occupational Health and Safety Approach; Occupational hazards- Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, Psychosocial hazards; Introduction to Occupational Safety and Health Administration (OSHA), Socio-economic aspects of occupational health and safety	15
II	**Accidents and their effects:** Theories of Accident Causation; Uniform Building Codes, International Building Codes, Falling Hazards / Walking and Working Surfaces; Machine Guarding; Lockout-Tagout; Electrical Hazards; Motor Vehicle Safety	15
III	**Risk factors:** The Effects of Physical Risk Factors on workers; Ways to Avoid Physical Risk Factors; Storage of Flammable Materials, Fire and Emergency; Fire Codes; Threshold Limit Values, Bloodborne Pathogens; Industrial Hygiene	15
IV	**Hazard prevention and control:** Prevention of occupational diseases- Medical measures, Engineering measures, Legislative measures, Occupational health in India; Personal Protective Equipment; Principles and Functions in Safety Management	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Koradecka, D., (2010). Handbook of Occupational Safety and Health, CRC Press: Taylor & Francis Group.
2. Hommadi, A. H. (1989). Environmental and Industrial Safety, I.B.B Publication, New Delhi.
3. Kolluru R. V, (1994). Environmental Strategies–Hand Book, Mc Graw Hill Inc., New York.
4. Goetsch D.L., (1999). "Occupational Safety and Health for Technologists", Engineers and Managers", Prentice Hall.
5. Pandey R. & Kanhere V. (1993). Activists' Handbook of Occupational Health and Safety, PRIA, New Delhi.
6. Luthra Usha, 1984, Occupational and Environmental Health Problems of Indian Women. Department of Science and Technology, Government of India.

DSE-H1

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	**Environmental Toxicology**	
Course Code	**B23-EVS-705**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To have knowledge relating to the fundamentals in the basic area of toxicology. 2. To acquire knowledge of different toxicants such as radiations, pesticides and heavy metals. 3. To understand about production, mode and evaluation of toxins and elaborate ecological impacts of GM crops and microorganisms 4. To apply the knowledge for risk assessment.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End-Term Exam Marks: 70**		**Exam Duration:** 3 hours
Part B- Contents of the Course		

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks

Unit	Topics	Contact Hours/Week
I	Toxicology: Introduction, definition, scope, history, principles of toxicology, classification of toxic agents, toxic responses, mechanisms of toxicity, routes of exposure, translocation of toxicants, Acute and chronic toxicity- LC50, LD50 Effects of toxicants, Toxicants in environmental samples.	15
II	Radiation sources in the environment- natural and man-made, biological effects of radiations, Pesticides-classification and effects, health effects of heavy metals and metalloids on human health, Fertilizers toxicity on land, water and its effects	15
III	Production of mycotoxins, fungal toxins, bacterial toxins, exo and endo toxins, viral toxins, algal toxins, teratogens, carcinogens and mutagens – causes, mode and evaluation, OccuOccupational diseases: Evaluation and control of occupational health hazards.	15
IV	Environmental Risk assessment : Introduction, definition, hazards identification, Risk characterization, Exposure assessment, Risk evaluation, Environmental health impact assessment, Advanced treatment methods-ultra filtration, reverse osmosis, adsorption.	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Casseret, L. J and Doull, J(1982) Toxicology. The basic science of Poisons. Macmillan Publishers, New York.
2. Stake, M. Y. Mido, M.s. Sethi, S.A. Iqbal, H. Yasuhisa, S. Taguchi (1997) environmental Toxicology, Discovery Publishing House, New Delhi3. Dc, A. K. (1986) Environmental Chemistry, Willey Eastern Limited, New Delhi.
3. Timbrel (1989) Elements Toxicology, British Council Library.
4. Trivedy, R. K (1994) Encyclopaedia of Environmental Pollution and Control, Enviromedia Publications, Karad.

PC-H1

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-7	
Name of the Course	**Practical Based on B23-EVS-701 TO 704/705**	
Course Code	**B23-EVS-706**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**PC-H1**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Apply knowledge of GIS and able to work with integration of remote sensing and GIS in various application fields 2. By the end of the course, students are expected to be able to gain insight into the basics of microbiology from practical aspects. 3. The students will be able to have a practical training on basic methods of statistical analysis and ecological modeling. 4. To develop skills and practical knowledge regarding risks and hazards associated at the workplaces, their causes and control measures. 5. Upon completion of this course, students will be able to analyse the different types of toxicants, sources and its effect	
Credits 4	Practicum	Total
	4	4
Contact Hours	8	8
Max. Marks:100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Exam Duration: 6 hours**

Part B- Contents of the Course		
Instructions for Paper- Setter For final practical exam time allowed will be of 6 hours. Two major and two minor practicals will be given to the students to write and perform in the laboratory.		
Unit	**Topics**	**Contact Hours/Week**
B23-EVS-701	1. To study land use land cover of an area using remote sensing and GIS. 2. To study forest fire of an area using remote sensing and GIS. 3. To study global distribution of atmospheric CO_2 and atmospheric temperature using remote sensing and GIS. 4. To study solid waste management using GPS and GIS. 5. To study the use of remote sensing and GIS in improving education system.	30
B23-EVS-702	1. Study of instruments and equipment used in the Microbiology Laboratory. 2. To prepare the basic nutrient media (Solid and Liquid) for routine cultivation of bacteria. 3. To perform catalase test on a bacterial strain. 4. To study the gram staining technique. 5. To study the effect of Temperature on bacterial growth.	30
B23-EVS-703	1. To study different types of graphs in MS Excel 2. To compute measures of central tendency with MS Excel 3. To compute the measures of dispersion with MS Excel 4. To prepare logistic model of population with the given population data set 5. To analyse a data statistically using one-way ANOVA	30
B23-EVS-704	1. A brief description/history of any building (and possibly jobs) and analysis of the associated safety and health hazards, prioritized by severity. 2. Recommendations for preventative or corrective measures for controlling hazards associated with the jobs identified and the buildings/grounds assigned (hierarchy of controls). 3. Case study on health and safety risks in mining. 4. Case study on health hazards in electronic industry. 5. Reporting and investigation of accidents in workplace and their preventive measures.	30

B23-EVS-705	1. To study the dose-response relationship. 2. A case study on the ecological impacts of genetically modified crops. 3. To calculate the LC50 and LD50 from a given data. 4. To distinguish the toxic and non-toxic ingredients in any products 5. Discuss and apply the safety and precautionary measures related to environmental toxicants and occupational exposures.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Practicum** □ Class Participation: 5 marks □ Demonstration/Viva-voce/Lab records: 10 marks □ Mid-Term Exam: 15 marks	**End Term Practicum Examination:** 70 marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.
2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
3. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India.
4. Kothari, C.R (1996). Quantitative Techniques, Vikas Publishing Housing Pvt Ltd, Hyderabad.
5. Khan, I.A and Kanum, A., (1994). Fundamentals of Bio-Statistics, Ukaaz Publication, Hyderabad
6. Koradecka, D., (2010). Handbook of Occupational Safety and Health, CRC Press: Taylor & Francis Group.
7. Hommadi, A. H. (1989). Environmental and Industrial Safety, I.B.B Publication, New Delhi.
8. Zakrzewski, S. F. (2002). Environmental toxicology. 3rd Ed. Oxford University Press.
9. Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001. Principles of Ecotoxicology. 2nd Ed. Taylor & Francis, London.

CC-H4

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Environmental Impact Assessment**	
Course Code	**B23-EVS-801**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**CC**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Understand the basic concepts and history of EIA. 2. Understand the existing situation of the project site with the help of baseline data collection. 3. Learn about the legislative framework governing EIAs, with a particular emphasis on how they are applied in India. 4. Evaluate the crucial role of EIAs in decision-making.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Exam Duration: 3 hours**
Part B- Contents of the Course		

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Introduction to Environmental Impact Assessment (EIA): Definition and related terms. Purpose and aims; core values and principles of Environmental Impact Assessment, Global significance of EIA.	15
II	The EIA Cycle and Procedures: project Screening, Scoping, Impact Prediction, Assessment of Alternatives, Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring	15
III	List of projects requiring Environmental clearance. Assessment of various environmental preparation of EMP (Environmental Management Plan). Mitigation strategies, Regulatory frameworks and laws governing EIA processes	15
IV	Environmental impacts of mining industry; nuclear power plant, textile industry; pulp and paper industry; petroleum refining; pesticide manufacturing industry; fertilizer industry thermal power plants	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
2. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
3. Wathern, P. (Ed.). (1988). Environmental Impact Assessment: Theory and Practice. Routledge.
4. Glasson, J., Therivel, R., & Chadwick, A. (2013). Introduction to Environmental Impact Assessment (4th ed.). Routledge.
5. Wood, C., & Glasson, R. (2006). Environmental Impact Assessment: A Comparative Review (2nd ed.).

CC-H5

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Research Methodology& Ethics**	
Course Code	**B23-EVS-802**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**CC**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course 1. To impart knowledge relating to the fundamentals in the basic area of research and ethical issues related to research 2. To understand and learn how to plan research topic. 3. To learn how to plan data collection, processing, report writing, bibliography and importance of workshops, seminars, conference and symposium in research 4. To elaborate Statistical approaches and modelling in environmental science.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Exam Duration: 3hours**
Part B- Contents of the Course		

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to

attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Definition of research, objectives of research, Characteristics of research, steps in research, applications and types of research, Methods of research, significance of research, Research ethics- definition and philosophy, Composition of Institutional Ethical Committee (IEC), Ethics in animal experimentation, Plagiarism- Concept and significance of plagiarism	15
II	Research problem, selecting and defining a research problem, Hypothesis- Meaning, function and types of hypotheses, Null/Alternative hypothesis, Variables- Meaning and types, Research design: Types of research design- exploratory, descriptive, diagnostic and experimental.	15
III	Primary and secondary data collection procedures, spatial and non-spatial data, Sampling Meaning and types of sampling, Probability and Non-Probability, Research reports: Writing preliminaries, main body of research, references and bibliography, Meaning and importance of workshop, seminar, conference, symposium etc. in research	15
IV	Databases: Indexing databases, Citation databases: Web of Science, Scopus. Research Metrics': Impact factor of journal, Citation reports, SNIP, SJR, Score; Metrics: h index, almetrics.	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Krishna Swamy K.N., Siva Kumar A.I., Mathirajan M., "Management Research Methodology (2006), Pearson Education, New Delhi.
2. Kothari C.R., "Research Methodology, Methods and Techniques, Second edition, (2008), New Age International Publication.
3. Ranjit Kumar : Research Methodology, A step by step guide for beginners, Pearson Education, Sixth Edition 2009.
4. Mark Saunders, Philip Lewis, Adrain Thornhiu: Research Methods for Business Students, Pearson

Education.

5. Ram Ahuja, “Research Methods”, (2001), Rawat Publications, New Delhi.
6. Cooper D., Schindler P., Business research methods”, (2003) Tata Mc-Graw Hill, New Delhi

CC-H6

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Environmental Economics**	
Course Code	**B23-EVS-803**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**CC**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course 1. Students will be able to understand the basic aspects of environmental economics 2. Students will students will be proficient in conducting comprehensive economic analyses of environmental challenges 3. The students will possess a comprehensive understanding of sustainability 4. Students will be equipped with the knowledge and skills to strategize and implement sustainable practices for natural resources	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Exam Duration: 3hours**

Part B- Contents of the Course

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Origin, scope and importance of environmental economics; Economics, environment and development: Economic categories of resources; the economics theory- market, demand and supply relationships, environmental externalities.	15
II	Ecosystem services and their valuation, The limit of growth; cost-benefit ratio; natural resources accounting; introduction to market-based mechanisms for environmental protection and pollution control; impact of climate change on the economy: national and global perspectives.	15
III	Definition and dimensions of sustainability; Guiding principles of sustainable development.; Sustainability indicators; An economic perspective to sustainability: the ecological footprint; environmental sustainability index; Education for Sustainability.	15
IV	Value addition in agriculture crops; Agricultural marketing; Economically sustainable forest management designs- green certification, resource conservation, community forest management; ecotourism; economic designs for renewable energy resources.	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Tietenberg T, Lewis L (2014) Environmental & Natural Resource Economics, 9th edition. Pearson.
2. Hanley N, Shogren JF, White B (2007) Environmental Economics in Theory and Practice, 2nd edition. Palgrave Macmillan.
3. Stern N (2007) The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge
4. Harris, J.M., Wise, T.A., Gallagher, K.P. and Goodwin, N.R. (2001). A Survey of Sustainable Development: Social and Economic Dimensions. Island Press, Washington, D.C.
5. 4. Smith, S. (2011). Environmental Economics: A Very Short Introduction, Oxford.

Session: 2025-2026		
Part A – Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Indian Knowledge System & Environment**	
Course Code	**B23-EVS-804**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**DSE**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1 Understand the principles of the Indian Knowledge System (IKS) related to the environment. 2 Analyze traditional ecological knowledge and its relevance in contemporary environmental conservation. 3 Explore case studies where IKS has been applied to solve environmental issues. 4 Develop practical skills for integrating IKS practices into modern environmental management.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 30) **End Term Exam Marks: 70** (Theory 70)		**Exam Duration: 3 hours**
Part B- Contents of the Course		

Instructions for Paper- Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q.No.1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Environment and Indian knowledge system, Historical Context of Indian Environmentalism and Importance of indigenous knowledge in environmental conservation, Overview of environmental philosophies in ancient Indian texts (e.g., Vedas, Upanishads, Aranyakas).	15
II	Traditional knowledge for sustainability: Traditional Agricultural Practices and farming methods Traditional methods of waste management and recycling. Traditional Water conservation and water harvesting techniques. Case studies related traditional systems.	15
III	Traditional knowledge for biodiversity conservation, sacred groves, and their significance in biodiversity conservation. Role of animals in Indian mythology and their conservation. Bishnoi community and their conservation efforts. Traditional method of weather forecast, traditional knowledge of potential uses of medicinal plants.	15
IV	Threats to traditional knowledge systems in the modern world, Integration of Traditional Knowledge in Modern Conservation. Evaluation of successful projects integrating traditional knowledge with modern conservation practices. Prospects in global environmental conservation efforts.	15

Suggested Evaluation Methods

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1 Altieri, M. A. (2002). Agroecology: The science of sustainable agriculture. CRC Press.

2 Mehta, B. S., & Singh, R. P. (2011). Traditional wisdom for modern times: Environment, science, and development. Sage Publications.

3 Singh, R. (2015). Water harvesting traditions in India. Journal of Water Resources and Management, 28(3), 234-245.

4 Pungetti, G., Oviedo, G., & Hooke, D. (Eds.). (2012). Sacred species and sites: Advances in biocultural conservation. Cambridge University Press.

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Space Mission for Earth System Monitoring**	
Course Code	B23-EVS-805	
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. To acquire knowledge about the global space mission agencies and legal framework for space missions. 2. To familiarize students with NASA's Earth Observation Missions. 3. To familiarize students with India's Earth Observation Missions. 4. To acquaint knowledge with Earth Observation Missions of other countries.	
Credits 4	Theory	Total
	4	4
Contact Hours	4	4
Max. Marks:100 **Internal Assessment Marks: 30** (Theory 30) **End Term Exam Marks: 70** (Theory 70)		**Exam Duration: 3 hours**
Part B - Contents of the Course		

Instructions for Paper-Setter

For final theory exam time allowed will be of 3 hours and nine questions will be set. Question No.1 (objective/short answer type) covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with two questions from each Unit. The candidates will be required to attempt Q. No. 1 and any four, selecting one question from each unit. All the questions will carry equal marks.

Unit	Topics	Contact Hours/Week
I	Governmental Space Mission Agencies: NASA, ESA, ISRO, CNES, JAXA, CNSA, etc. Commercial Space Mission Agencies: International Space Station. FedEO, Group on Earth Observations (GEO). Legal Framework for Space Race: UNOOSA, ISRO, The Indian Space Policy 2023.	15
II	India's Earth Observation Missions: Rohini, Bhaskara, IRS series, Resourcesat series, Cartosat series, EOS series, RISAT Series, Oceansat series, HyIS, PSLV-C37 satellite mission, YouthSat, NISAR.	15
III	NASA Earth Observation Missions: Mission details of Landsat series, ICESat, Aqua, Aura, Terra, MERRA, CALIPSO, NOAA-N, OCO, CloudSat, Transporter-1 mission.	15
IV	ESA Earth Observation Missions: Copernicus - Sentinel series, CHIME, CIMR, CO2M, CRISTAL, CryoSat, ERS series, SMOS, FLEX, Biomass mission, EUMETSAT.	15

Suggested Evaluation Methods

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

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1. Observation of the Earth and its environment: survey of missions and sensors. (2014). H. J. Kramer. Springer-Verlag.
2. Earth Observations from Space: The First 50 Years of Scientific Achievements. (2008). National Research Council. Washington, DC: The National Academies Press.
3. Small Satellite Missions for Earth Observation: New Developments and Trends. (2010).
4. Ed. Rainer Sandau, Hans-Peter Roeser, Arnoldo Valenzuela. Springer-Verlag.
5. Distributed Space Missions for Earth System Monitoring. (2012). Ed. Marco D'Errico. 1st ed., Springer.

Session: 2025-2026		
Part A - Introduction		
Subject	Environmental Science	
Semester	SEMESTER-8	
Name of the Course	**Practical Based on B23-EVS-801 TO 804/805**	
Course Code	**B23-EVS-806**	
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	**PC-H2**	
Level of the course (As per Annexure-I	400-499	
Pre-requisite for the course (if any)	NA	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Develop the ability to comprehensively identify and list potential environmental, social, and economic impacts of a hypothetical project. 2. By the end of the course, students are expected to be able to gain insight into the basics of writing scientific research papers. 3. The students will be able to have practical training on basic methods of statistical analysis and ecological economics. 4. To develop skills and practical knowledge regarding Evaluating traditional adaptation strategies to climate change impacts. 5. Analyze various satellite missions, space policies, and atmospheric data retrieval techniques to comprehend the applications, evolution, and environmental monitoring capabilities of space technology.	
Credits 4	Practical	Total
	4	4
Contact Hours	8	8
Max. Marks:100 **Internal Assessment Marks: 30** **End-Term Exam Marks: 70**		**Exam duration: 6 hours**

Part B- Contents of the Course		
Instructions for Paper-Setter For the final practical exam time allowed will be of 6 hours. Two major and two minor practicals will be given to the students to write and perform in the laboratory.		
Unit	**Topics**	**Contact Hours**
B23-EVS-801	1. To study the environmental components (e.g., air, water, soil, noise, biodiversity) for a baseline study of the project site. 2. Prepare a list of projects that require a complete Environmental Impact Assessment. 3. To predict the potential Environmental impact of a given project and list them. 4. Based on the impact prediction results from Practical 3, students will identify appropriate mitigation measures for each significant impact. 5. To identify the potential impacts of a hypothetical project and list them.	30
B23-EVS-802	1. To study about bibliographic arrangement of references and citations. 2. To study the preparation of a manuscript for publication of a research paper. 3. To learn about writing a literature review of a scientific paper. 4. To study the use of plagiarism checker software available online. 5. To study about the drafting of a questionnaire	30
B23-EVS-803	1. To draw the market equilibrium using a given set of data. 2. To interpret the case study on the cost-benefit ratio of a proposed project. 3. To develop a comprehensive plan for adding value to an agricultural product. 4. To study about various green certification programmes in India 5. To interpret the case study on sustainable planning and development	30
B23-EVS-804	1. To investigate and compare the different traditional water conservation and management techniques used in different regions of India. 2. To investigate the traditional uses of plants in the indigenous community and their conservation significance. 3. list out the biodiversity conservation and wildlife conservation efforts by Indian Govt. 4. Compare the soil health by collecting samples from different study sites with different agricultural practices. 5. To access traditional coping mechanisms and adaptations strategies in response to climate change impacts.	30

or B23-EVS-805	1. Study of Landsat series of NASA missions. 2. Study of the historical development of India's satellite missions. 3. Study of India's PSLV-C37 satellite mission. 4. Study of Copernicus Sentinel mission. 5. Study of the Indian Space Policy 2023.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Practical** • Lab record: 10 marks • Viva-voce: 5 marks • Lab performance: 15 marks	**End Term Practical Examination:** 70 marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Morris, P., & Therivel, R. (Eds.). (2001). Methods of environmental impact assessment (Vol. 2). Taylor & Francis.
2. Pears, R., & Shields, G. (2004). Cite them right. Hampshire: Palgrave MacMillan.
3. Boardman, A. E., Greenberg, D. H., Vining, A. R., Weimer, D. L., & Analysis, C. B. (2018). Concepts and Practice.
4. Khan, I.A and Kanum, A., (1994). Fundamentals of Bio-Statistics, Ukaaz Publication, Hyderabad
5. Silva, K. D., & Sinha, A. (2017). Cultural landscapes of South Asia. *South Asia: Routledge*.
6. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.
7. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
8. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India.

ANNEXURE-I

Levels of Courses

Levels of Courses: Courses shall be coded based on the learning outcomes, level of difficulty, and academic rigor. The coding structure is as follows:

0-99: Pre-requisite courses required to undertake an introductory course which will be a pass or fail course with no credits. It will replace the existing informal way of offering bridge courses that are conducted in some of the colleges/ universities.

100-199: Foundation or introductory courses that are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses may also be prerequisites for courses in the major subject. These courses generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up more advanced courses. These courses seek to equip students with the general education needed for advanced study, expose students to the breadth of different fields of study; provide a foundation for specialized higher-level coursework; acquaint students with the breadth of (inter) disciplinary fields in the arts, humanities, social sciences, and natural sciences, and to the historical and contemporary assumptions and practices of vocational or professional fields; and to lay the foundation for higher level coursework.

200-299: Intermediate-level courses including subject-specific courses intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses.

300-399: Higher-level courses which are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.

400-499: Advanced courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year Postgraduate theoretical and practical courses.

500-599: Courses at first-year Master's degree level for a 2-year Master's degree programme

600-699: Courses for second-year of 2-year Master's or 1-year Master's degree programme

700 -799 & above: Courses limited to doctoral students