

KURUKSHETRA UNIVERSITY
KURUKSHETRA
(“A+” Grade Accredited by NAAC)

Scheme of Examination and Syllabus for
Under-Graduate Programme
(Subject: Environmental Science)

Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-
2020w.e.f. 2023-24 (in phased manner)

**INSTITUTE OF ENVIRONMENTAL STUDIES,
KURUKSHETRA UNIVERSITY, KURUKSHETRA**
Scheme of Examination Subject: Environmental Science for Under-Graduate Programme
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24 (in phased manner)

FIRST YEAR: SEMESTER-1									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A & C	CC-1 MCC-1 4 credit	B23 - EVS -101	Earth & Environment	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	MCC-2 4 credit	B23 - EVS -102	Natural Resources	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A	CC-M1 2 credit	B23 - EVS -103	Environment and Social Issues	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A & C	MDC-1 3 credits	B23 - EVS -104	Basics of Environmental Sciences	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme C only	CC-M1 4 credit	From Available CC-M1 of 4 credits as per NEP							
Scheme A & C	AEC-1 2 credit	From Available AEC-1 of two credits as per NEP							
	SEC-1 3 credit	From Available SEC-1 of three credits as per NEP							
	VAC-1 2 credit	From Available VAC-1 of two credits as per NEP							
FIRST YEAR: SEMESTER-2									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A & C	CC-2 MCC-3 4 credit	B23 - EVS -201	Fundamentals of Ecology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	DSEC-2 4 credit	B23 - EVS -202	Techniques of Environmental Analysis	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A only	CC-M2 2 credit	B23 - EVS -203	Climate Change	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A & C	MDC-2 3 credits	B23 - EVS -204	Environmental Issues	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

Scheme C only	CC-M2 4 credit	From Available CC-M2 of 4 credits as per NEP
Scheme A & C	AEC-2 2 credit	From Available AEC-2 of two credits as per NEP
	SEC-2 3 credit	From Available SEC-2 of three credits as per NEP
	VAC-2 2 credit	From Available VAC-2 of two credits as per NEP
Internship of 4 credits of 4-6 weeks duration after 2nd Semester		

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SECOND YEAR: SEMESTER-3									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-3 MCC-4 4 credit	B23-EVS-301	Introduction to Biodiversity	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-5 4 credit	B23-EVS-302	Disaster Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	MDC-3 3 credits	B23-EVS-303	Environmental Conservation	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme A & C	CC-M3 4 credits	From Available CC-M3 of 4 credits as per NEP							
Scheme B only	CC-M3 (V) 4 credits	From Available CC-M3(V) of 4 credits as per NEP							
Scheme A, B & C	AEC-3 2 credit	From Available AEC-3 of two credits as per NEP							
	SEC-3 3 credit	From Available SEC-3 of three credits as per NEP							
Scheme C only	VAC-3 2 credits	From Available VAC-3 of two credits as per NEP							
Scheme B only	MCC-3	MCC-2 FROM SCHEME C OF FIRST SEMESTER							
SECOND YEAR: SEMESTER-4									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-4 MCC-6 4 credit	B23-EVS-401	Environmental Pollution and Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-7 4 credit	B23-EVS-402	Land Degradation and Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-8 4 credit	B23-EVS-403	Environmental Chemistry	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-1 4 credit Select one option	B23-EVS-404	Solid Waste Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

		B23-EVS-405	Liquid Waste Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	CC-M4(V) 4 credits	From Available CC-M4(V) of 4 credits as per NEP							
	AEC-4 2 credit	From Available AEC-3 of two credits as per NEP							
Scheme C only	VAC-4 2 credits	From Available VAC-4 of two credits as per NEP							
Scheme A & B	VAC-3 2 credits	From Available VAC-3 of two credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

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THIRD YEAR: SEMESTER-5									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-5 MCC-9 4 credit	B23-EVS-501	Environmental Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-10 4 credit	B23-EVS-502	Water Resource and Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-2 4 credit Select one Option	B23-EVS-503	Agroforestry and Agroecology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-EVS-504	Ecological Restoration	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-3 4 credit Select one Option	B23-EVS-505	Biomedical and E-Waste Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-EVS-506	Hazardous Waste Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A & C	CC-M5(V) 4 credits	From Available CC-M5(V) of 4 credits as per NEP							
Scheme A, B & C	Internship 4 credits	Internship#4 credit after 4 th semester							
THIRD YEAR: SEMESTER-6									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme	CC-6		Basics of Remote Sensing	3	3	20	50	70	3 hrs.

A, B & C	MCC-11 4 credit	B23-EVS-601	and GIS						
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-12 4 credit	B23-EVS-602	Waste Management	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-4 4 credit Select one Option	B23-EVS-603	Environmental Legislation	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-EVS-604	Environmental Management System and Standards	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-5 4 credit Select one Option	B23-EVS-605	Energy and Environment	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-EVS-606	Renewable & New Energy Sources	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A only	CC-M6 4 credits	From Available CC-M6 of 4 credits as per NEP							
Scheme A only	CC-M7(V) 4 credits	From Available CC-M7(V) of 4 credits as per NEP							
Scheme B only	CC-M5(V) 4 credits	From Available CC-M5(V) of 4 credits as per NEP							
Scheme C only	CC-M6(V) 4 credits	From Available CC-M6(V) of 4 credits as per NEP							
Scheme C only	SEC-4 2 credit	From Available SEC-4 of two credits as per NEP							

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FOURTH YEAR: SEMESTER-7 (FOR HONOURS/HONOURS WITH RESEARCH)

Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
for Honours in Environmental Science /Honours with Research in Environmental Science	CC-H1 4 credit	B23-EVS-701	Applications of Remote Sensing and GIS	4	4	30	70	100	3 hrs.
	CC-H2 4 credit	B23-EVS-702	Environmental Microbiology	4	4	30	70	100	3 hrs.
	CC-H3 4 credit	B23-EVS-703	Environmental Statistics & Modeling	4	4	30	70	100	3 hrs.
	DSE-H1 4 credit Select one Option	B23-EVS-704	Occupational Health & Safety	4	4	30	70	100	3 hrs.
		B23-EVS-705	Environmental Toxicology	4	4	30	70	100	3 hrs.
(For Scheme B & C)	PC-H1 4 credit	B23-EVS-706	Practical Based on B23-EVS-701 TO 704/705	4	8	30	70	100	6 hrs.
	CC-HM1 4 credit	From Available Minor of 4 credits as per NEP							

SEMESTER-8 (FOR HONOURS)

Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Honours in Environmental Science (For Scheme B & C)	CC-H4 4 credit	B23-EVS-801	Environmental Impact Assessment	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-EVS-802	Research Methodology & Ethics	4	4	30	70	100	3 hrs.
	CC-H6 4 credit	B23-EVS-803	Environmental Economics	4	4	30	70	100	3 hrs.
	DSE-H2 4 credit	B23-EVS-804	Indian Knowledge System & Environment	4	4	30	70	100	3 hrs.
	Select one option	B23-EVS-805	Space Mission for Earth System Monitoring	4	4	30	70	100	3 hrs.
	PC-H2 4 credit	B23-EVS-806	Practical Based on B23-EVS-801 TO 804/805	4	8	30	70	100	6 hrs.
CC-HM2 4 credit	From Available Minor of 4 credits as per NEP								
OR SEMESTER-8 (FOR HONOURS WITH RESEARCH)									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Honours with Research in Environmental Science (For Scheme B & C)	CC-H4 4 credit	B23-EVS-801	Environmental Impact Assessment	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-EVS-802	Research Methodology & Ethics	4	4	30	70	100	3 hrs.
	Project/Dissertation 12 credit	B23-EVS-807	Project/Dissertation	8+4	-	-	300	300	-
	CC-HM2 4 credit	From Available Minor of 4 credits as per NEP							

CC-1/MCC-1

Session: 2023-2024			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-1		
Name of the Course	EARTH AND ENVIRONMENT		
Course Code	B23-EVS-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To have knowledge of the origination of Earth with help of various theories and understanding the Earth's system processes. 2. To acquire knowledge of the structure and key components of the biophysical environment. 3. To understand different types of geological disasters and mitigation measures. 4. To describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes. <hr/> <p>5*. To apply the knowledge after studying various theoretical aspects of biophysical environment in investigating the Earth's structure, extraction methods of the geological resources, impact of a natural disaster and resolving present day environmental issues arising out of adverse human impact on the present-day environment.</p>		
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)		Time: 3hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
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
I	Origin of the Earth, Earth's orbit, Kepler's laws of planetary motion. Structure of the Earth - the Geosphere, Atmosphere and Hydrosphere. Theory of Plate Tectonics - Wegener theory of continental drift, Holmes theory of convection in the mantle, Hess theory of sea floor spreading, Vine and Matthews theory of magnetic reversals and Glomar Challenger theory of age of oceanic floors. Role of energy in Earth's processes - convection currents, photosynthesis and water cycle.		03 hours/ week
II	Non-renewable geological resources - minerals, fossil fuels and ores of economic significance. Geological disasters - earthquake, landslide, cyclones and volcanic eruptions. Impact of human activities on to the frequency and magnitude of natural disasters - droughts, floods, forest fire, landslides. Mitigation of geological disasters - building codes, early-warning systems and education. Impact of human on land - salinization, soil erosion, soil contamination; rehabilitation of salinity-affected area, methods of soil erosion prevention.		
III	Physical and chemical properties of sea water and their spatial variations. Residence times of elements in sea water. Ocean currents, waves and tides. Major water masses of the world's oceans. Impact of human on water resources; reuse of different types of		

	water - industrial wastewater, sewage and stormwater, concept of zero waste discharge.	
IV	<p>Chemical composition of the atmosphere, lapse rate and stability. CLOsud formation and precipitation processes, air-sea interactions. Insolation and heat budget, general circulation of the atmosphere and ocean. General weather systems of India - Monsoon system, cyCLOsne and jet stream; western disturbances.</p> <p>Effect of introduced species on the environment - biotic and abiotic effects, impact on the decline or extinction of native species, economic impacts of the species; control and mitigation methods.</p>	
V*	<p>Practical's</p> <ol style="list-style-type: none"> 1. Investigate evidence for the structure of the Earth using meteorite evidence to demonstrate its composition. 2. Investigate the locations and extraction methods of the geological resources – open-pit mining, underground mining methods, offshore and onshore drilling. 3. Investigate the zero waste discharge from a residential area. 4. Investigate the rehabilitation of salinity-affected area by preparing a case study. 5. Investigate volcanic eruption that has had a significant effect on the biosphere and atmosphere and assess its impact by preparing a case study. 	02 hours/ week
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 		<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written examination) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and Keller E.A (2004). *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
2. Francisco B., Frances S.H., Juno H., Gerhard K. and Stephen A. L. (2007). *Earth Science: Geology, the Environment, and the Universe*. Glencoe/McGraw-Hill.
3. Steffen, W., Sanderson, A., Tyson, P.D., Jager, J., Matson, P.M., Moore, III, B., Oldfield, F., Richardson, K., Schnellhuber, H.J., Turner, II, B.L. and Wasson. R.J (2004). *Global change and the Earth System: A Planet under Pressure*. Springer-Verlag, New York, New York, USA Reference books.

*Applicable for courses having practical component.

MCC-2

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-1		
Name of the Course	NATURAL RESOURCES		
Course Code	B23-EVS-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	After completing this course, the learner will be able to: <ol style="list-style-type: none"> 1. To understand about natural resources, their types and realize the importance of resources. 2. To acquire deep knowledge about land and forest resources. 3. To understand status of water resources and food resources. 4. To describes energy resources and mineral resources. <hr style="width: 20%; margin-left: 0;"/> 5*. To identify, study and map natural resources of India.		
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)		Time: 3hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
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
I	Natural Resources: definition, resource availability and factors acting their availability; major types of natural resources, renewable and non-renewable resources; economic categories of resources, interaction of human with natural resources.	03 hours/week
II	Land as a resource, types of lands, importance, ecological significance and economic importance of soil, effect of land use changes. Food resources, green revolution, effects of modern agriculture, world food problems, food security.	
III	Water resources – status, availability, demand, utilization sectors-domestic, industrial, agriculture, hydrological cycle, global water resources, surface and ground water, interlinking of rivers, water resources in India and their importance. Forest resources: forest types, primary and secondary products, utilization and economic importance, forest and tribal people, forest resources of India.	
IV	Energy resources: types, renewable (solar, wind, hydro and biomass) and non-renewable (coal, petroleum and natural gas) Mineral resources: types, availability, distribution, global consumption patterns.	
V*	Practical's 1. To identify and study some important minerals. 2. To study and map different soil types in India. 3. To study and map different forest in India. 4. To study and map different water resources in India. 5. To plot energy consumption scenario in pi-diagram in Indian context.	02 hours/ week

Suggested Evaluation Methods

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> ● Class Participation: 5 marks ● Seminar/presentation/assignment/quiz/class test etc.: 5 marks ● Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> ● Class Participation: NA ● Demonstration/Viva-voce/Lab records etc.: 10 marks ● Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
Recommended Books/e-resources/LMS:	
<ol style="list-style-type: none"> 1. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India. 2. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). <i>Ecology, Environment and Resource Conservation</i>, S. Chand Publishing, New Delhi. 3. Owen, O. S. & Chiras, D. D. (1990). Natural resource conservation: an ecological approach (No. Ed. 5). Macmillan Publishing Company. 4. Holechek, J. L., Cole, R. A., Fisher, J. T. & Valdez, R. (2000). Natural resources: ecology, economics, and policy (No. HC85. N37 2003.). Upper Saddle River, NJ: Prentice Hall. 5. Owen, O. S. & Chiras, D. D. (1995). Natural resource conservation: management for a sustainable future (No. Ed. 6). Prentice-Hall International, Inc.. 6. Craig, J.R., Vaughan, D.J. & Skinner, B.J. 1996. Resources of the Earth: Origin, use, and environmental impact (2nd edition). Prentice Hall, New Jersey. 7. Klee, G.A. 1991. Conservation of Natural Resources. Prentice Hall Publication. 8. Miller, T.G. 2012. Environmental Science. Wadsworth Publishing Co. 9. Ramakrishna, P.S., A. N. Purohit, K.G. Saxena, K.S. Rao & R.K. Maikhuri (1996) <i>Conservation and management of biological resources in Himalaya</i>, Oxford & IBH Publishing, New Delhi. 	

*Applicable for courses having practical component.

CC-M1

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-1		
Name of the Course	ENVIRONMENT AND SOCIAL ISSUES		
Course Code	B23- EVS-103		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To develop a multi-perspective analysis of pre-historic environment to the present condition. 2. Understand the issues of resource inequality, ecological degradation, environmental pollution. 3. Understand the impact of industrialization and technology on environment. 4. Able to find the solutions for the various environmental issues through case studies. <hr/> <p>5*. To critically relate the social issues arising from the human development and its impact on environment and to suggest possible solutions.</p>		
Credits 2	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks:15 (Theory 10 +Practical 05) End Term Exam Marks: 35 (Theory 20 + Practical 15)		Time: 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
I	Introduction : Social and cultural aspects of environment, Environmental thought from historical and contemporary perspective; Environmental education and Ethics, Poverty and environment, Environment and tribal community, Article 48A, Environmental Justice, Role of NGT in Environment Protection.	01 hour/ week
II	Historical developments in cultural, social and economic issues related to water, forest and land management, Issues of resource inequality, Ecological degradation-causes and impacts, environmental pollution; development-induced displacement, Global Climate change, Industrial disasters-Bhopal Gas Tragedy, Fukushima Disaster.	
III	Production and consumption oriented approaches to environmental issues in Indian and global context, impact of industrialization and technology on environment; urban sprawl, traffic congestion, lifestyle changes and environment, Sustainability - global, regional, and local environmental policies, Ecotourism and sustainability, Green urbanism and architecture, Ecological Footprint.	
IV	Rehabilitation and Resettlement, individual, National level initiatives to initiatives to ensure sustainable development, Promising new technologies, Community participation, Case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan, Namami Gange); corporate responsibility movement; environmental groups and movements, role of NGOs in environment protection, Eco-restoration, Environmental Awards.	

V*	Practical's 1.To study the importance of NGT through case study 2. To study the importance of Article -48A through case study. 3. To study the impact of man-made hazard on environment through case study. 4. To compare the ecological footprints of different countries. 5. To study the importance of community participation in environment protection through case study.	02hours/ week
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> ● Class Participation: 04 marks ● Seminar/presentation/assignment/quiz/class test etc.: NA ● Mid-Term Exam: 06 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> ● Class Participation: NA ● Demonstration/Viva-voce/Lab records etc.: 05 marks ● Mid-Term Exam: NA 		<p style="text-align: center;">End Term Examination:</p> <p>Theory: 20 marks (Written exam)</p> <p>Practical: 15 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources		
<p>Suggested readings:</p> <ol style="list-style-type: none"> 1. Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. Understanding Environment. Sagar Publication India Pvt. Ltd., New Delhi. 2. Elliot, D. 2003. Energy, Society and Environment, Technology for a Sustainable Future. Routledge Press. 3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi. 4. National Research Council (NRC). 1996. Linking Science and Technology to Society's Environmental Goals. National Academy Press. 		

*Applicable for courses having practical component.

MDC-1

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-1		
Name of the Course	BASICS OF ENVIRONMENT SCIENCE		
Course Code	B23-EVS-104		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Become familiar with the principles of Environment Science and acquire knowledge about environment and sustainability. 2. Build an understanding of Earth's structure; soil formation, degradation and reclamation 3. Learn about atmosphere structure and Atmospheric processes. 4. Become familiar with the Global water balance and Hydrological cycle. <hr/> <p>5*. Gain practical knowledge about the analysis of water and soil quality parameters</p>		
Credits 3	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75		Time: 3hours	
Internal Assessment Marks: 20 (Theory 15 +Practical 05)			
End Term Exam Marks: 55 (Theory 35 + Practical 20)			
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
I	Environment science: Basic concept of environmental science; Components of Environment; Interactions of various components of the environment; Principle of environment science; Environment and sustainability; Sustainable development goals.	02 hours/ week
II	Earth system: Structure and composition of earth system; Soil formation (pedogenesis); Weathering and Types of Weathering; Soil types; Soil profiles; Soil degradation and desertification; Methodologies for soil Conservation.	
III	Atmosphere: Structure and composition of the atmosphere; Components of the atmosphere; Distinction of temperature and pressure in the atmosphere; Concept of heat budget of the atmosphere; Temperature inversion; Ozone Depletion; Water in the atmosphere-Acid rain.	
IV	Hydrosphere: Hydrosphere components; Sources of water; Global Water balance; Types of water; Hydrological cycle; Significance of hydrosphere.	
V*	Practical's <ol style="list-style-type: none"> 1. To study the soil profile and do draw the labeled diagram. 2. To measure soil temperature and moisture. 3. To determine water quality parameters with the help of an analysis kit. 4. Draw the pie diagram showing the global water balance. 5. To study the structure of the atmosphere with the help of a label diagram 	02 hours/ week
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.: 04 marks • Mid-Term Exam: 07 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 05 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 35 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested readings</p> <ol style="list-style-type: none"> 1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). <i>Ecology, Environment and Resource Conservation</i>. S. Chand Publishing, New Delhi 2. Botkin, D.B and Kodler, E.A. (2000). <i>Environment Studies:the earth as a living planet</i>. John Wiley and Sons Inc. 3. Cunningham, W.P. and Cunningham, M.A. (2002). <i>Environmental Science: Inquiry and Applications</i>. A Global Concern. Tata McGraw-Hill Publishing Company, New Delhi. 4. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). <i>Soils and Environmental Quality</i>. Second Edition. CRC press, New York. 	

*Applicable for courses having practical component.

CC-2/MCC-3

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-2		
Name of the Course	FUNDAMENTALS OF ECOLOGY		
Course Code	B23-EVS-201		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1.Understand the basic aspects of ecology 2.Understand the basic concepts of ecosystem dynamics and stability 3.Gain knowledge about concepts of population and their interactions 4.Understand community ecology and succession process in nature. <hr style="width: 50%; margin-left: auto; margin-right: auto;"/> <p>5*. Have a practical training on basic aspects of ecology.</p>		
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)		Time: 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
I	<p>Definition, Scope and basic principles of ecology and environment. Biological levels of organization. Climatic, Edaphic and Topographical Factors; Habitat and ecological niche.</p> <p>Laws of limiting factors; Liebig's Law of the Minimum; Shelford's Law of Tolerance;</p>	03 hours/ week
II	<p>The Ecosystem Concept, Structure and Function of Ecosystem. Trophic levels, food chains and food webs. Ecological pyramids, Energy flow and in ecological systems, energy efficiencies. Biogeochemical Cycles.</p> <p>Ecosystem stability: resistance and resilience. Ecotypes; Ecads; Ecoclines.</p>	
III	<p>Population: Basic concepts, population characteristics – density, natality, mortality, age-structure, population growth. Ecological niche and habitat. Positive and negative interactions of populations – competition, predation, parasitism, mutualism.</p>	
IV	<p>Community structure and organization, keystone species, ecotone and edge effect. Methods of plant community analysis.</p> <p>Succession: Concepts of succession, Types of Succession. Trends in succession. Climax and stability.</p>	
V*	<p>Practical's</p> <ol style="list-style-type: none"> 1. To study different method of plant community analysis 2. To determine minimum size of quadrat to study herbaceous vegetation 3. To determine minimum number of quadrats to study herbaceous vegetation 4. To study different components of an ecosystem 5. To prepare a check list of invasive species 	02hours/ week
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Odum, E.P. (1983). <i>Basic Ecology</i>. Sanders, Philadelphia. 2. Odum, E.P. (1971). <i>Fundamentals of Ecology</i>. W.B. Saunders. 3. Robert, R. (2001). <i>The Ecology of Nature</i>. Fifth Edition. W.H. Freeman and Company. 4. Smith, R.L. (1996). <i>Ecology and Field Biology</i>. Harper Collins, New York. 5. Botkin, D.B. & Keller, E.A. (2000). <i>Environment Science: Earth as a living planet</i>. Third Edition. John Wiley and Sons Inc. 6. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). <i>Ecology, Environment and Resource Conservation</i>. Anamaya Publications. 	

*Applicable for courses having practical component.

DSEC-1

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-2		
Name of the Course	TECHNIQUES OF ENVIRONMENTAL ANALYSIS		
Course Code	B23-EVS-202		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSEC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 To describes physical, chemical, nutrient, and microbial properties of the soil. 2. To have knowledge about the physical, chemical and biological properties of the water. 3. To describes the air quality of a geographical area. 4. To describes the level of ambient noise of a geographical area. <hr/> <p>5*.To apply practical techniques to understand the physical, chemical and biological properties in the environmental samples.</p>		
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)		Time: 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
I	<p>Analysis of physical properties of the soil: soil texture by particle size distribution (PSA) through hydrometer method, soil pH, soil bulk density, porosity, temperature, colour and resistivity. Analysis of organic matter in the soil - wet dichromate acid oxidation method, Walkley-Black method.</p> <p>Analysis of the soil nutrients - nitrogen using Kjeldahl method, phosphorus using molybdate-blue method, potassium using spectroscopic method.</p> <p>Soil microbial activity analysis: enumeration and isolation of soil microbes - plate count method, MPN technique.</p> <p>Measurement of soil enzyme activity - spectrophotometric and titrimetric method.</p>	03 hours/ week
II	<p>Physicochemical analysis of the water samples: DO (DO Meter or Winkler modified method), BOD (dilution method), COD (Potassium dichromate method), electrical conductivity (Conductivity meter), pH, Carbonate-bicarbonate as CaCO (titrimetric method), turbidity (gravimetry), Na and K (Flame photometry), Ca and Mg (EDTA Titrimetric), Chloride (Argentometric titration), fluoride (Ion meter, colorimetry), phosphate, nitrogen and nitrate-nitrite (colorimetry).</p> <p>Microbial analysis of water samples using membrane-filtration method, MPN and presence-absence tests.</p>	
III	<p>Parameters and methods of ambient air samples analysis: SO₂ (West and Gaeke Method), NO₂ (Jacob & Hochheiser modified (NaOH-NaAsO₂ method), PM_{2.5} and PM₁₀ (Gravimetric and TEOM), As, Ni and Pb (AAS/ICP Method), NH₃ (Chemiluminescence).</p>	
IV	<p>Noise monitoring using instrumentation - sound level meter and its functioning, ambient noise monitoring system, noise monitoring station, analysis of ambient noise monitoring on daily, monthly and annual basis.</p>	

V*	Practical's 1. Investigate the physical properties of the given soil sample. 2. Investigate the DO and BOD of the given water sample for drinking purpose. 3. Investigate the particulate matter (PM _{2.5} and PM ₁₀) in ambient air on monthly basis using a case study data. 4. Investigate the ambient noise monitoring on monthly basis using a case study data. 5. To enumeration the soil microbes from a given soil sample using plate count method.	02 hours/ week
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.: 05 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 		<p style="text-align: center;">End Term Examination:</p> Theory: 50 marks (Written exam) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)
Part C-Learning Resources		
<p>Suggested Readings:</p> 1. Chaudhery, M.H. and Rustem, K. (2019). <i>Modern Environmental Analysis Techniques for Pollutants</i> . Elsevier. 2. Patnaik, P. (2017). <i>Handbook of Environmental Analysis</i> .CRC Press. 3. Gupta, P.K. (2000). <i>Methods in Environmental Analysis : Water Soil and Air</i> . Agrobios (India) Publications.		

*Applicable for courses having practical component.

CC-M2

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-2		
Name of the Course	Climate Change		
Course Code	B23-EVS- 203		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Learn about the origin, composition and structure of the atmosphere and about Earth's energy balance. 2. Understand the concept of changing climate, sources, and trends. 3. Learn about various impacts of climate change on the environment. 4. Gain knowledge on mitigation strategies adopted worldwide. <hr/> <p>5*. To develop research aptitude in climate change research.</p>		
Credits 2	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks:15 (Theory 10 +Practical 05) End Term Exam Marks: 35 (Theory 20 + Practical 15)		Time: 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
I	Introduction: Weather and climate; Atmosphere – origin, composition, structure, basic atmospheric properties; Radiations and Earth's energy balance.	01 hour/ week
II	Global atmospheric temperature, Greenhouse gases – sources and trends in GHGs emission, role of aerosol, ozone and trace gases; Global warming, Climate change, Climate variability in geological history, natural and human induced climate change.	
III	Impact of climate change: weather extreme, Sea level rise, Coral bleaching, Extinction risk of temperature sensitive species, melting of snow, ice and glaciers.	
IV	Mitigation strategies for global warming; biological carbon sequestration, carbon sequestration in geological formations, role of forests in carbon sequestration; Kyoto protocol, IPCC.	
V*	Practical's <ol style="list-style-type: none"> 1. To plot the decade wise trend of atmospheric CO₂ 2. To draw a well label diagram of different types of radiations. 3. To plot melting trends of Gangotri glacier 4. To measure temperatures to learn about the greenhouse effect 5. To demonstrate how melting ice affects sea levels. 	
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.: NA • Mid-Term Exam: 06 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 05 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 20 marks (Written exam)</p> <p>Practical: 15 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). <i>Ecology, Environment and Resource Conservation</i>, S. Chand Publishing, New Delhi. 2. Miller Jr., G.T. (1997). <i>Environmental Science: Working With the Earth</i>. Wadsworth Publishing Company, Belmont, California 3. Botkin, D.B. and E.A. Keller (2004). <i>Environment Science: Earth as a Living Planet</i>, John Wiley & Sons Inc., New York. 4. Philander, S.G. (ed.) (2008). <i>Encyclopedia of global warming and climate change</i>. 2nd edition, SAGE Publications, Inc., California. 5. Steffen, W., A. Sanderson, P. D. Tyson, J. Jager, P. M. Matson, B. Moore, III, F. Oldfield, K. Richardson, H. J. Schnellhuber, B. L. Turner, II, and R. J. Wasson. (2004). <i>Global change and the Earth system: a Planet under Pressure</i>. Springer-Verlag, New York, New York, USA. 	

*Applicable for courses having practical component.

MDC-2

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-2		
Name of the Course	ENVIRONMENTAL ISSUES		
Course Code	B23-EVS- 204		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Students will gain knowledge about environmental issues related to industrialization and urbanization. 2. Students will be able to understand the issues related to population explosion, degradation, pollution 3. The students will gain knowledge about major global environmental issues. 4. Students will understand the issues related to energy and water consumption and international efforts for environmental protection. <hr/> <p>5*. Students will be able have and practical insight on local and global environmental issues.</p>		
Credits 3	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks:75 Internal Assessment Marks: 20 (Theory 15 +Practical 05) End Term Exam Marks: 55 (Theory 35 + Practical 20)		Time: 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
I	Environment and Development; Industrialization: impact of industry and technology on environment; Production and consumption-oriented approaches to environmental issues Urbanization: urban sprawl, traffic congestion and social-economic problems.	02 hours/ week
II	Population Explosion and Ecological degradation; deforestation; environmental pollution; epidemics, development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms.	
III	Significant global environmental issues: acid rain, climate change, biodiversity loss; ozone layer depletion, resource depletion and conservation; interface between environment and society. Sustainable development	
IV	Nature, scope and analysis of local and global impacts of energy use on the environment; Issues related to water use, distribution and scarcity; International concerns and efforts for environmental protection: Role of United Nations, Stockholm Summit, Rio Summit	
V*	Practical's 1. To prepare a case study of local environmental issues in your surroundings. 2. To analyse the status of forest cover in the state of Haryana. 3. To study and analyse the trends of global climate change 4. To analyse the impacts of acid rain on historic monuments: a case study of TajMahal. 5. To prepare a report on international efforts for environmental protection	02 hours/ week
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> ● Class Participation: 04 marks ● Seminar/presentation/assignment/quiz/class test etc.: 04 marks ● Mid-Term Exam: 07 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> ● Class Participation: NA ● Demonstration/Viva-voce/Lab records etc.: 05 marks ● Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 35 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggesting Readings:</p> <ol style="list-style-type: none"> 1. Singh, J.S., Singh, S.P. & Gupta, S.R. (2017). Ecology, Environment and Conservation. S.Chand (G/L) & Company Ltd. 2. <u>Kumar, A. & Roy, P. K. (2008). Environmental Issues and Solutions. Daya Publishing House, New Delhi</u> 3. Vashishtha, A. & Johari, S. (2020). Case Studies: Contemporary Environmental Issues and Challenges. Bloomsbury Publishing. 4. Sudhir, M.A. & Masillamani, M.A. (2003). Environmental Issues. Reliance Publishing House. 5. Gope, A., Sarkar, A., Sarkar, P., Majumdar, S. & Gosai. K. (2019). Environmental Issues & Sustainable Development. Notion Press Media Pvt Ltd. 6. Rangarajan, M. (2006). Environmental Issues in India: A Reader. Pearson Education India. 	

*Applicable for courses having practical component.

CC-3/MCC-4

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-3		
Name of the Course	Introduction to Biodiversity		
Course Code	B23-EVS-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Become aware about biodiversity, types of biodiversity, Concept of speciation. 2. Acquire knowledge about levels of biodiversity, Concept of Hotspot of Biodiversity 3. Gain knowledge about biodiversity uses, services and threats to biodiversity 4. Become familiar with the various biodiversity conservation strategies and approaches. <hr style="width: 20%; margin-left: auto; margin-right: auto;"/> <p style="text-align: center;">—</p> <ol style="list-style-type: none"> 5*. Acquire practical knowledge about the biodiversity of various ecosystems and at various levels 		
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)		Time: 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
I	Definition, History and importance of Biodiversity; Concept of species and speciation ; Genetic variations, natural selection, genetic drift and gene flow; Biodiversity, magnitude, global accumulation; levels of biodiversity - species, genetic and ecosystem diversity; species diversity indices.	03 hours/ week
II	Biodiversity gradient – latitudinal and altitudinal; Biodiversity at global, national and local levels; Concept of hotspot of biodiversity; Criteria for determining hot spots; India as a Mega Diversity Nation. Indian hotspots diversity: Indo-Burma (Eastern Himalaya), Western Ghats, Sri Lanka and Sundaland; Biodiversity of mangroves, wetlands and coral reefs – A general account	
III	Value of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Biodiversity uses and ecosystem services. Threats to biodiversity- habitat loss, habitat fragmentation, exotic species and environmental pollution; species extinction. Concept of IUCN threat categories; Concept of Red data book; Endangered and threatened species of India.	
IV	Approaches for Conservation of Biological diversity. <i>In-situ</i> and <i>ex-situ</i> conservation. In situ conservation.- Protected areas, Wildlife sanctuaries, National parks, Biosphere reserves. Strategies for ex situ conservation – Botanical Gardens, Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation.	
V*	<p>Practical's</p> <ol style="list-style-type: none"> 1. Determination of requisite size of quadrat for vegetation analysis. 2. Analysis of frequency distribution of plants in a grassland ecosystem by quadrant method 3. To determine basal cover of a tree in a forest ecosystem. 4. Field Survey in your campus for studying plant 	02 hours/ week

	<p>species diversity</p> <p>5. Preparation of field report based on visit of a wildlife sanctuary/zoo/national park/ biosphere reserve</p> <p>6. Determination of alpha, beta and gamma biodiversity with help of given data</p>	
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>	
Part C-Learning Resources		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Chandel, K.P.S., Shukla, G. and Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India Conservation and Utilization, National Bureau of Plant Genetic Resources, New Delhi. 2. Heywood, V. (ed.) (1995). Global Biodiversity Assessment. United Nations Environment Programme, Cambridge University Press, Cambridge, U.K. 3. Gabriel M. (2000) Biodiversity and conservation Oxford and IBH publishing company Pvt Ltd. New Delhi. 4. Krishnamoorthy, K.V (2004) An Advanced text book on Biodiversity- principles and Practice: Oxford and IBH publishing company Pvt. Ltd. New Delhi. 5. Maiti, P. K. and Maiti, P. (2023). Biodiversity: perception, peril and preservation. PHI Learning Pvt. Ltd. 6. Huston, M.A. (1994). Biological Diversity: The Coexistence of Species on Changing Landscapes. Cambridge University Press, Cambridge. 7. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi. 8. Soule, M.E. (ed.) (1986): Conservation Biology. The Science of Scarcity and Diversity. Sinaur Associates, Inc., Sunderland, Massachusetts. 		

*Applicable for courses having practical component.

MCC-5			
Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-3		
Name of the Course	Disaster Management		
Course Code	B23-EVS-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To have basic conceptual understanding of disasters. 2. To understand the causes, types and impacts of natural disasters. 3. To understand the different types of manmade disasters and their effects. 4. To build skills to respond to disaster and to understand the prevention, preparedness and mitigation for disaster. <hr style="width: 30%; margin-left: auto; margin-right: auto;"/> <p>5*. To develop practical skills about disasters and their management</p>		
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)		Time: 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
I	Introduction to disaster: Definition, difference between hazard and disaster, understanding natural and manmade disasters, risk and vulnerability in disaster, reasons of disaster- population growth, urban expansion, pollution, epidemics, accidents. Disaster profile of India.	03 hours/ week
II	Natural disaster: Earthquake- causes, types and impacts; Floods- types and impacts; landslides- responsible factors, causes and effects; drought: different types of droughts- meteorological, agricultural, hydrological and effects; cyclones and hurricanes; tsunamis: reasons and its impacts.	
III	Anthropogenic disaster: Types, causes and effects of: Technological hazards- Industrial hazards, Structural collapse, Power outage, Fire (building fire and forest fire), CBRN: Chemical disasters, biological disasters, Radiological disaster, Nuclear disasters, Sociological hazards- Crime, Terrorism, War.	
IV	Disaster Preparedness and mitigation: Definition, Disaster management cycle of earthquake, floods, drought, landslides and cyclone: prevention, preparation and mitigation, Disaster Information, Disaster Response: Disaster Rehabilitation, Reconstruction and Recovery. Role of National Disaster Management Authority (NDMA).	
V*	Practical's 1. Preparation of disaster management plan for earthquake and report submission. 2. Preparation of disaster management plan for flood and report submission. 3. Study on national and international disasters in recent year. 4. Report submission on Dos and Do not at individual or household levels, during and after a disaster earthquake. 5. Report submission on Dos and Do not at individual or	02 hours/ week

	household levels, during and after a disaster flood.	
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> ● Class Participation: 05 marks ● Seminar/presentation/assignment/quiz/class test etc.: 05 marks ● Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> ● Class Participation: NA ● Demonstration/Viva-voce/Lab records etc.: 10 marks ● Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>	
Part C-Learning Resources		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Singh V., Aleya L., Singh M., and Singh K.K. (2010). <i>Natural Disaster</i>, APH Publishing Corporation New Delhi. 2. Sahni P., Dhamija A. and Medury U. (2011). <i>Disaster Mitigation: Experiences and Reflections</i>, PHI; New title edition. 3. Pandey, M. (2014). <i>Disaster Management</i>, Wiley India Pvt. Ltd. 4. Rajan C.K. and Pandharinath N. (2009) <i>Earth and Atmospheric Disaster Management: Nature and Manmade</i> S Publication, Hyderabad. 5. Sharma S.C. (2021). <i>Disaster Management</i>, Khanna Publishing House,2021. 6. Murthy D.B.N. (2019). <i>Disaster Management</i>. Deep and Deep Publication PVT.Ltd. New Delhi. 		

*Applicable for courses having practical component.

MDC-3

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-3		
Name of the Course	Environmental Conservation		
Course Code	B23-EVS-303		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	MDC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To understand overview of problems associated with natural resources and conservation aspects. 2. To acquire deep acquaintance about land degradation and water conservation methods. 3. To recognize and explain forest conservation and mineral resource conservation strategies. 4. To describes energy conservation technologies and practices. <hr/> <p>5*. To attain practical knowledge on environmental conservation approaches in India.</p>		
Credits 3	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 (Theory 15 +Practical 05) End Term Exam Marks: 55 (Theory 35 + Practical 20)		Time: 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
I	Resource degradation and conservation, human impact on natural resources, importance of environmental conservation, equitable use and conservation for sustainable lifestyles. Environmentally friendly technology, natural resources accounting, market-based mechanisms for environmental protection, role of an individual and NGOs in environmental conservation. IPR and Traditional Knowledge.	02 hours/ week
II	Land degradation, deforestation, desertification, soil erosion and control, sustainable land use planning, effects of modern agriculture, fertilizer-pesticide problems, agroforestry, afforestation and reforestation, reclamation & management of waste lands (case studies). Conflicts over water (International & Inter-state), Interlinking of rivers, water conservation methods, rain water harvesting, watershed management.	
III	Forest conservation practices, sustainable forest management designs- green certification, community forest management (case study); ecotourism, conservation of biodiversity. Mineral resources exploitation, types of mining and environmental impacts, conservation and recycling of minerals.	
IV	Environmental impacts of different forms of energy, efficient use of energy resources, alternate energy sources, Delhi CNG case study, Cogeneration of energy (case studies) Bioenergy, biogas, biofuels, IPR and Traditional Knowledge.	
V*	Practical's 1. Case study interlinking of rivers in India. 2. Visit to place/institution/fields having sustainable soil conservation practices. 3. To list down the different irrigation practices in India. 4. To study solar power installations in your campus/area/city. 5. To visit Sewage treatment plant in your campus/area/city.	02 hours/ week

Suggested Evaluation Methods	
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.: 04 marks • Mid-Term Exam: 07 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 05 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 35 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). <i>Ecology, Environment and Resource Conservation</i>, S. Chand Publishing, New Delhi. 2. Owen, O. S., & Chiras, D. D. (1990). <i>Natural resource conservation: an ecological approach</i> (No. Ed. 5). Macmillan Publishing Company. 3. Biswas, A. K. (2007) <i>Water resources: Environmental Planning, Management, and Development</i>, McGraw-Hill, New Delhi. 4. Ladle, Richard and Richard J. Ladle (2009) <i>Biodiversity and Conservation: Response to biodiversity loss</i>, Taylor and Francis. 5. Singh, J. S et al. 1997, <i>Restoration of Degraded Lands, concepts & strategies</i>, Rastogi Publication. 6. Bansil, P.C. 2004. <i>Water Management in India</i>. Concept Publishing Company, India. 	

*Applicable for courses having practical component.

CC-4/MCC-6

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-4		
Name of the Course	Environmental Pollution and Management		
Course Code	B23-EVS-401		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Gain knowledge on the types and classification of air and noise pollution. 2. Link causes and effect of water and soil pollution on environment and human health. 3. Identify various control measures of pollution. 4. Link various biological measures to control pollution and the existing challenges to solve pollution mitigation strategies. <hr style="width: 20%; margin-left: auto; margin-right: auto;"/> <p>5*. To analyze physiochemical properties of waste water and contaminated soil.</p>		
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)		Time: 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
I	Air Pollution: Sources, classification (primary and secondary) and properties of air pollutants, indoor air pollution, effects of air pollution on human health, Air Quality index, Air quality standards, Remedial measures to control Air pollution Noise pollution: sources frequency, intensity and permissible ambient noise levels; impacts on living organisms and humans, measures to control noise pollution.	03 hours/ week
II	Water Pollution: Sources, consequences of water pollution, Agriculture and Water pollution, Pesticides and drinking water, Sanitation and drinking Water, Marine pollution-sources and effects, Thermal pollution and its effects, water quality parameters and standards, Remedial measures to control water pollution. Soil Pollution: Sources, consequences of soil pollution and control measures, Radioactive material and sources of radioactive pollution; effect of radiation on human health.	03 hours/ week
III	Air scrubbers, Electrostatic Precipitators, Baghouse filters, Impingers, Case study: implementation of CNG.Noise control meters, Air sparging, Land farming, Phytoremediation, bio-remediation; Biological mediated pollution control.	03 hours/ week
IV	Activated Sludge Process (ASP),Trickling Filters, oxidation ponds, membrane bioreactor, ETP sludge management; up flow anaerobic sludge blanket reactor, hybrid reactors, bio scrubbers, bio trickling filters; regulatory framework for pollution monitoring and control, Coastal area management; existing challenges and management techniques. Case study: Ganga Action Plan; Yamuna Action Plan.	03 hours/ week
V*	Practical's 1. Identification and listing of different types of air, water and soil pollutants in the locality. 2. Enlist the measures to control noise pollution in homes and industries. 3. Study the functioning of water treatment or sewage treatment	02 hours/ week

	plant-Case study 4. To study about the pH, EC and salinity of waste water and contaminated soil 5. To study about the BOD and COD of the waste water.	
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>	
Part C-Learning Resources		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Gurjar, B.R., Molina, L.T. & Ojha C.S.P. (2010). Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis. 2. Park, K. (2015). Park's Textbook of Preventive and Social Medicine (23rd edition). Banarsidas Bhanot Publishers. 3. Gupta, P.K. (2000). Methods in Environmental Analysis : Water Soil and Air. Agrobios (India) Publications. 4. Purohit, S.S. & Ranjan, R. (2007). Ecology, Environment & Pollution. Agrobios Publications. 5. Singh, J.S., Singh, S.P. & Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi. 		

*Applicable for courses having practical component.

MCC-7

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-4		
Name of the Course	Land Degradation and Management		
Course Code	B23-EVS-402		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To understand the process of soil formation and different properties of soil 2. To know the different causes responsible for land degradation 3. To acquire knowledge about the indicators and impacts of land degradation 4. To learn the methods for reclamation and management of degraded land <hr/> <p>5*. To develop skills and practical knowledge regarding soil properties and texture as well as will be able to identify the degraded land</p>		
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)		Time: 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
I	Basics of soil science: Soil as a resource; soil formation; soil profile; classification of soil; Properties of soil: soil texture, alkalinity and acidity, soil moisture, soil salinity, soil temperature, water holding potential; soil organic matter; nutrients in soil; decomposition and mulching, soil biodiversity.	03 hours/ week
II	Land degradation: Definition; Causes of land degradation-deforestation; fertilizers and pesticides; unsustainable agricultural practices; urban expansion; overgrazing; salinization; soil acidification; water logging; nutrient depletion; soil pollution; mining; soil erosion; desertification.	
III	Indicators and Impacts of land degradation: Indicators of degraded land: development of rills, gullies, pedestals and armour Layer, tree root exposure and tree mound; Impacts on agriculture; impacts on biodiversity; reduction in productivity; loss of ecosystem services; impacts on nutrient cycles; impacts on environment.	
IV	Land degradation Management: Integrated soil fertility management; management of farming practices; sustainable land use management; Irrigation system management; maintenance of soil productive capacity; reclamation of mining affected areas; waste management; afforestation; reclamation of chemically degraded soil; community-based education and awareness.	
V*	Practical's <ol style="list-style-type: none"> 1. Determination of physical properties (pH, EC etc.) of soil 2. Analysis of texture (pore size) of soil 3. Measurement of water holding capacity in soil 4. Case study of a degraded land 5. Identification of different grasses used for soil conservation. 	02 hours/ week

Suggested Evaluation Methods	
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Brady, N.C., Weil, R.R. and Weil, R.R. 2008. The nature and properties of soils (Vol. 13). Upper Saddle River, NJ: Prentice Hall. 2. Bhattacharyya, R., Ghosh, B.N., Mishra, P.K., Mandal, B., Rao, C.S., Sarkar, D., Das, K., Anil, K.S., Lalitha, M., Hati, K.M. and Franzluebbbers, A.J. 2015. Soil degradation in India: Challenges and potential solutions. Sustainability, 7(4), pp.3528-3570. 3. Gadgil, M. 1993. Biodiversity and India's degraded lands. Ambio 22: 167-172. 4. Johnson, D.L. 2006. Land Degradation (2nd edition). Rowman& Littlefield Publishers. 5. Marsh, W. M. & Dozier, J. 1983. Landscape Planning: Environmental Applications. John Wiley and Sons. 6. Oldeman, L. R. 1994. The global extent of soil degradation. Soil resilience and sustainable land use, 9. (http://library.wur.nl/isric/fulltext/isricu_i26803_001.pdf). 7. Mishra, P.K., Rai, A., Abdelrahman, K., Rai, S.C. and Tiwari, A. 2022. Land degradation, overland flow, soil erosion, and nutrient loss in the Eastern Himalayas, India. Land, 11(2), p.179. 8. Peterson, G. D., Cumming, G. S. & Carpenter, S. R. 2003. Scenario planning: a tool for conservation in an uncertain world. Conservation Biology 17: 358-366. 9. Scherr, S. J. 1999. Soil degradation: A threat to developing-country food security by 2020? (Vol. 27). International Food Policy Research Institute. 	

*Applicable for courses having practical component.

MCC-8

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-4		
Name of the Course	Environmental Chemistry		
Course Code	B23-EVS -403		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1: Obtain basic knowledge about reactions in water. 2: Learn about atmospheric reactions, smog, acid rain and ozone layer depletion. 3: Develop understanding on the concept of rocks and soil chemistry. 4: Develop understanding about metals and organic chemicals in environment <hr/> <p>5*. To develop research aptitude in environmental chemistry research</p>		
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)		Time: 3hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			

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
I	Fundamentals of aquatic chemistry: acid-base, solubility, oxidation-reduction, and complexation reactions. Basic principles of sedimentation, coagulation, filtration and absorption. Gases in water.	03 hours/ week
II	The atmospheric chemistry: Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; chemistry of acid rain. ozone layer depletion, role of CFCs in ozone depletion.	
III	Soil chemistry: Structure and Properties of Minerals, Types of minerals and rocks, Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil.	
IV	Fate of metals and organic chemicals in environment: Lead, mercury, arsenic, cadmium. Dioxins, PCBs. Sources of hydrocarbons. Persistent organic pollutants.	
V*	Practical's <ol style="list-style-type: none"> 1. To analyze pH and EC in given water samples. 2. To analyze pH and EC in soil samples. 3. To measure soil temperature and moisture. 4. To study the relationship between population growth and CO₂ concentration in atmosphere. 5. To study the relationship between CO₂ concentration in atmosphere and mean earth temperature. 	02 hours/ week
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> ● Class Participation: 5 marks ● Seminar/presentation/assignment/quiz/class test etc.: 5 marks ● Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> ● Class Participation: NA ● Demonstration/Viva-voce/Lab records etc.: 10 marks ● Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. A. K. De (2019). <i>Environmental Chemistry</i>. New Age International Publishers, Publisher 2. Botkin, D.B. and Keller E.A (2004). <i>Environment Science: Earth as a Living Plant</i>. John Wiley & Sons Inc., New York. 3. Manahan, S.E. (2000). <i>Environmental Chemistry</i>. Seventh Edition. Lewis Publishers, New York 4. Mitsch, W.J. and Jorgensen, S.E. (eds.) (1989). <i>Ecological Engineering: An Introduction to Ecotechnology</i>. John Wiley and Sons, New York. 5. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). <i>Soils and Environmental Quality</i>. Second Edition. CRC press, New York. 	

*Applicable for courses having practical component.

DSE-1

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-4		
Name of the Course	Solid Waste Management		
Course Code	B23-EVS-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To enhance the knowledge of students about different sources, types and classification of solid waste. 2. To know about storage, collection and transportation of solid waste. 3. To learn the different waste management methods. 4. To acquire knowledge regarding waste management rules and initiatives by government. <hr/> <p>5*. To develop practical learning about collection, storage, classification and disposal methods of solid waste by surveying their own locality.</p>		
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)		Time: 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
I	Introduction to solid waste: Definition; types of solid waste: Domestic Waste, commercial waste, industrial waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste, construction and demolition waste. Classification of solid waste- hazardous and non-hazardous, degradable and non-degradable.	03 hours/ week
II	Processing of solid waste: Storage, Collection and Transportation of solid waste: waste segregation and storage, Collection methods of solid waste- tools and equipment, transportation of waste- types of vehicles, role of rag pickers and their utility for society.	
III	Disposal of Municipal solid waste: 5-Rs and their benefits: Refuse, Reduces, Reuse, Repurpose and Recycle; methods of waste disposal: composting, anaerobic digestion, incineration, pyrolysis, gasification and landfills.	
IV	Integrated waste management and Policies: Impact of solid waste on environment, human and plant health. Integrated waste management: concept and importance; waste management hierarchy; Solid Waste Management Rules 2016; Swachh Bharat Mission 2014; Vocational aspects of waste management.	
V*	Practical's <ol style="list-style-type: none"> 1. Estimate the moisture content and specific weight of solid waste sample 2. Collection, segregation and measurement of waste into biodegradable and non-biodegradable waste 3. Classification of household waste into different components 4. Survey your locality and identify different methods of handling, separation and storage household solid waste. 5. Survey your locality and identify different methods of waste 	02 hours/ week

	disposal.	
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.: 05 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 		<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Kumar, S. (2009). <i>Solid Waste Management</i>, Northern Book Centre New Delhi. 2. Ramchandra, T.V. (2009), <i>Management of Municipal Solid Waste</i>, TERI Press, the Energy and Resource Institute, Lodhi Road New Delhi. 3. Singh J. and Ramanathan A.L. (2010). <i>Solid Waste Management: Present and Future Challenges</i>, International Publishing House Pvt. Ltd. New Delhi. 4. Muthuraman L. and Ramaswamy S. (2018). <i>Solid Waste Management</i>, MJP Publishers Chennai. 		

*Applicable for courses having practical component.

DSE-1

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	SEMESTER-4		
Name of the Course	Liquid Waste Management		
Course Code	B23-EVS-405		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLOs):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1: Understand the sources, types, and health importance of liquid waste. 2: Obtain basic knowledge of waste water collection and transport. 3: Understand the working principles of different types of wastewater treatment. 4: Learn about storm water and sludge management. <hr/> <p>5*. To acquire practical knowledge about liquid waste characteristics.</p>		
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)		Time: 3hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			

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
I	Sources, types and quantities of liquid waste; health importance of liquid waste: diseases associated to excreta and their transmission; characteristics of wastewater and sewage.	03 hours/ week
II	Wastewater collection: Septic tanks, Seepage pits, Cesspools. Conveyance of liquid wastes: small bore grey water drainage system, simplified sewer system conventional piped sewer system, and septage transport; ISI tolerance limits for discharging treated waste water and treated sewage water and industrial effluents into surface water, into public sewers and on to land for irrigation.	
III	Liquid waste treatment: Primary treatment: sedimentation, coagulation and flocculation, filtration; Secondary treatment: aerobic and anaerobic treatment; activated sludge process, rotating biological filters; Tertiary treatment: nitrification and denitrification processes, phosphorous removal.	
IV	Advanced waste water treatment: ion exchange, electro-dialysis, reverse osmosis, and ultra filtration. Disinfection of water: different types of disinfectants. Sludge management: dewatering, sludge stabilization, and sludge drying beds. Storm water management. Excreta and waste water management in disaster situations. Gobar Dhan scheme.	
V*	Practical's <ol style="list-style-type: none"> 1. To analyze the pH and EC of inlet sewage water samples. 2. To analyze the pH and EC of outlet sewage water samples. 3. To analyze the BOD of inlet sewage water samples. 4. To analyze the BOD of outlet sewage water samples. 5. To calculate the efficiency of sewage treatment plant based on given data. 	02 hours/ week
Suggested Evaluation Methods		

<p style="text-align: center;">Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 marks • Seminar/presentation/assignment/quiz/class test etc.: 5 marks • Mid-Term Exam: 10 marks <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Demonstration/Viva-voce/Lab records etc.: 10 marks • Mid-Term Exam: NA 	<p style="text-align: center;">End Term Examination:</p> <p>Theory: 50 marks (Written exam)</p> <p>Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)</p>
Part C-Learning Resources	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Metcalf and Eddy. (1995). <i>Waste water Engineering – Collection, Treatment, Disposal and Reuse</i>. McGraw Hill Pub. Co. 2. Rao, M.N. & Dutta, A.K. (1982). <i>Waste Water Treatment</i>. 3rd Edition, IBH Publishers, 3. A. K. De. (2019). <i>Environmental Chemistry</i>. New Age International Publishers, Publisher 4. Manahan, S.E. (2000). <i>Environmental Chemistry</i>. Seventh Edition. Lewis Publishers, New York. 	

*Applicable for courses having practical component.

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

KURUKSHETRA UNIVERSITY
KURUKSHETRA
(“A+” Grade Accredited by NAAC)

Scheme of VAC-2 course for
Under-Graduate Programme
(Subject: Environmental Science)

Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24 (in phased manner)

VAC 2 B23-VAC-201

Session: 2023-24			
Part A - Introduction			
Subject	Environmental Science		
Semester	I/ II		
Name of the Course	Environmental Studies		
Course Code	B23-VAC-201		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concept of environmental studies, sustainable development and ecosystem. 2. Learn about the various natural resources and about biodiversity and its conservation. 3. Know about the types of pollution, solid waste management, global environmental issues and environmental laws. 4. Understand the concept of population growth and its impacts on environment and disaster management. 		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3 hours	

Part B- Contents of the Course		
<u>Instructions for Paper- Setter</u>		
Total number of questions set will be nine. Questions no. 1 is compulsory covering the entire syllabus. Two questions will be set from each unit. Students have to attempt five questions in all, selecting one question from each unit including the compulsory question. Each question is of 7 marks. All questions carry equal marks. Final theory exam time allowed will be of 3 hours.		
Unit	Topics	Contact Hours
I	<p>Introduction to environmental studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.</p> <p>Ecosystems: Definition, structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs, Major ecosystems types: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystem (lakes, rivers, oceans).</p>	6
II	<p>Natural resources: Renewable and Non- renewable Resources</p> <p>Land resources: Land degradation and soil erosion.</p> <p>Forest resources: Importance of forests, deforestation: causes and impacts on environment.</p> <p>Water resources: Use and over- exploitation of surface and ground water.</p> <p>Energy resources: Renewable and non- renewable energy sources.</p> <p>Biodiversity and Conservation:</p> <p>Definition and its types, Endangered and endemic species of India.</p> <p>Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation biodiversity: <i>In-situ</i> and <i>Ex-situ</i> conservation of biodiversity.</p> <p>Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational values.</p>	9

III	<p>Environmental pollution Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution. Solid waste management: Sources, methods of disposal: Landfill, incineration and composting. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environmental Policies & Practices Environmental laws: Environment (Protection) Act, 1986, Air (Prevention & Control of Pollution) Act, 1981, Water (Prevention and control of Pollution) Act, 1974.</p>	8
IV	<p>Human Communities and the Environment: Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected person. Disaster management: floods, earthquake, cyclones, landslides and drought. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.</p>	7
Suggested Evaluation Methods		
<p style="text-align: center;">Internal Assessment:15 marks</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 4 marks • Seminar/presentation/assignment/quiz/class test etc.: 4marks • Mid-Term Exam: 7 marks 		<p>End Term Examination: Theory: 35 marks (Written exam)</p>
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
<ol style="list-style-type: none"> 1. Kaushik, A & Kaushik, C.P. 2022. Perspectives in Environmental Studies. New Age International Pvt Ltd, New Delhi. 2. Bharucha, E. 2021. A Textbook of Environmental Studies for Undergraduate Courses, Orient Blackswan Pvt Ltd. 3. Goswami, P., Mandal, J. & Singh, S. 2022. A Textbook on Environmental Studies, Ashok book stall, Assam. 4. Joshi, P.C. & Joshi, N. 2009. A Text Book of Environmental Science. APH Publishing Corporation. 5. Basu, M. & Xavier Savarimuthu, S.J. 2017. Fundamentals of Environmental Studies. Cambridge University Press. 6. Singh, R.P. & Islam, Z. 2012. Environmental Studies. Concept Publishing Company. 		

KURUKSHETRA UNIVERSITY
KURUKSHETRA
(“A+” Grade Accredited by NAAC)

Scheme of SEC-215, SEC-218, SEC-317
courses for
Under-Graduate Programme
(Subject: Environmental Science)

Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-
2020w.e.f. 2023-24 (in phased manner)

**INSTITUTE OF ENVIRONMENTAL STUDIES,
KURUKSHETRA UNIVERSITY, KURUKSHETRA**
Scheme of SEC courses Subject: Environmental Science for Under-Graduate Programme
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24 (in phased manner)

SECOND YEAR: SEMESTER-4									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	SEC 3 credit	B23-SEC-215	Food Waste and By-Product Utilization	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme A, B & C	SEC 3 credit	B23-SEC-218	Environmental Auditing	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme A, B & C	SEC 3 credit	B23-SEC-317	Waste Management Techniques	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.

B23-SEC-215

Session: 2023-24	
Part A - Introduction	
Subject	Life Science
Semester	II
Name of the Course	Food Waste and By-Product Utilization
Course Code	B23-SEC-215
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	SEC
Level of the course (As per Annexure-I)	Intermediate-level
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	<p>After the successful completion of course, the students will be able to</p> <ol style="list-style-type: none"> 1. Understand the concept of food waste and its impact on the environment, economy, and society. 2. Explore different techniques and technologies for food waste management and reduction 3. Understand sustainable strategies for utilizing food waste and by-products to create value-added products. 4. Understand various applications of food waste by-products. 5. *Apply theoretical knowledge to practical scenarios related to food waste and by-product utilization

Credits	Theory	Practical	Total
	2	1	3
Contact Hours (per week)	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 (Theory 15 + Practical 05) End Term Exam Marks: 55 (Theory 35 + Practical 20)		Time: 3 Hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
<p>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.</p>			
Unit	Topics		Contact Hours
I	Introduction to Food Waste: Definition and types of food waste; Environmental, economic, and social impacts of food waste; Food waste throughout the supply chain; Factors Contributing to Food Waste; Post-harvest losses and storage challenges; Retail and consumer-related food waste; Food waste in foodservice establishments and restaurants		8
II	Food Waste Management and Reduction: Source reduction strategies; Food donation and redistribution programs; Composting and anaerobic digestion; Innovative technologies for food waste reduction		7
III	Overview of by-product utilization; Extraction of bioactive compounds from food waste; Conversion of food waste into biofuels and energy; Recovery of value-added materials from		8

	food waste	
IV	Applications of Food Waste By-Products; Food industry applications (e.g., food additives, functional ingredients); Animal feed and pet food production; Fertilizer and soil amendment production; Waste-to-packaging concepts; Policy frameworks and regulations	7
V*	<ol style="list-style-type: none"> 1. To conduct an on-campus food waste audit 2. To study the process of composting to convert food waste to compost. 3. To study the process of anaerobic digestion to convert food waste to biogas. 4. To study a successful food waste and by-product utilization project. 5. To visit a local food processing industry and prepare a report. 	30
Suggested Evaluation Methods		
Internal Assessment: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> ● Class Participation: 4 marks ● Seminar/presentation/assignment/quiz/class test etc.: 4 marks ● Mid-Term Exam: 7 marks ➤ Practicum <ul style="list-style-type: none"> ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc.: 5 marks ● Mid-Term Exam: NA 		End Term Examination: Theory: 35 marks (Written exam) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ol style="list-style-type: none"> 1. Subbulakshmi, G., Udipi, S.A. and Ghurge, P.S. 2021. Food Processing and Preservation. New Age International Private Limited 2. Westendorf, M. L. 2007. Food Waste to Animal Feed. John Wiley (WSE & Wiley India). 3. Arvanitoyannis, I.S. 2008. Waste Management for the Food Industries (Food Science and Technology). Academic Press Inc. 4. Joshi, V. K. and Sharma, S. K. 2011. Food Processing waste Management. New India Publishing Agency 5. Waldron, K. 2007. Handbook of Waste Management and Co-Product Recovery in Food 		

Processing. Woodhead Publishing Limited, Cambridge, England

*Applicable for courses having practical component.

B23-SEC-218

Session: 2023-24	
Part A - Introduction	
Subject	Life Science
Semester	II
Name of the Course	Environmental Auditing
Course Code	B23-SEC-218
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	SEC
Level of the course (As per Annexure-I)	Intermediate-level
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To have knowledge of the origin, scope and requisites of the environmental audit. 2. To develop understanding about the environmental audit process. 3. To understand the basis of environmental audit in India. 4. To describe career aspects in environmental audit. 5*. To apply the knowledge after studying various theoretical aspects of environmental audit in maintaining a sustainable environment.

Credits	Theory	Practical	Total
		2	1
Contact Hours (per week)	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 (Theory 15 + Practical 05) End Term Exam Marks: 55 (Theory 35 + Practical 20)		Time: 3 Hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
<p>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.</p>			
Unit	Topics	Contact Hours	
I	Environmental Audit: Definition; Historical background - International and Indian. Objectives and scope; Benefits for sustainable development. Importance of environmental audit for the public, industries and the governments.	8	
II	GOI Notification on Environmental Audit - The Environment (Protection) Act, 1986; EIA notification 2006 - Prior EC requirements, authority and committees, categorisation of projects and activities require EC.	7	
III	Component of environmental audit, stages in the EIA. Appraisal process, application structure of EIA documents - ToR, different forms. Validity of EC, Post-EC monitoring.	8	
IV	Need of public hearing in EIA, methods of public hearing. Environmental auditing firms, industry good practices to maintain a healthy environment, vocational aspects of	7	

	environmental audit.	
V*	<ol style="list-style-type: none"> 1. Environmental auditing of a new township project - a case study. 2. Public participation in the EIA process - a sand mining project as a case study. 3. Environmental audit in India - a MoEF&CC owned environmental clearance portal as a case study. 4. Raising FAR in a building project - through different methods of raising environmental performance. 5. Different environmental audit institutions in India. 	30
Suggested Evaluation Methods		
Internal Assessment: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> ● Class Participation: 4 marks ● Seminar/presentation/assignment/quiz/class test etc.: 04 marks ● Mid-Term Exam: 07 marks ➤ Practicum <ul style="list-style-type: none"> ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc.: 5 marks ● Mid-Term Exam: NA 		End Term Examination: Theory: 35 marks (Written exam) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ol style="list-style-type: none"> 1. Shrivastava, A. K. (2003). Environmental auditing. 1st Ed., APH Publishing. 2. Pathak, H. (2015). Environmental Audit. 1st Ed., Createspace Independent Publications. 		

*Applicable for courses having practical component.

B23-SEC-317

Session: 2023-24			
Part A - Introduction			
Subject	Life Science		
Semester	III		
Name of the Course	Waste Management Techniques		
Course Code	B23-SEC-317		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	SEC		
Level of the course (As per Annexure-I)	Intermediate-level		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Identify various types of wastes and their sources 2. Understand the sanitary landfill and other disposal method for solid waste. 3. Understand the treatment methods for waste water. 4. Examine the role of biotechnology in reduction of different waste. 5*. To compare the different waste treatment techniques and suggest for better environment. 		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours (per week)	2	2	4

Max. Marks: 75 Internal Assessment Marks: 20 (Theory 15 + Practical 05) End Term Exam Marks: 55 (Theory 35 + Practical 20)		Time: 3 Hours
Part B- Contents of the Course		
<u>Instructions for Paper- Setter</u>		
<p>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.</p>		
Unit	Topics	Contact Hours
I	<p>Waste: Classification, generations and characterization. Basic aspects of Solid waste management generation; on-site handling, storage and processing; collection of solid wastes; transfer and transport; processing techniques; ultimate disposal.</p> <p>Hazardous waste –Definition, sources, effects, disposal and management techniques. Physical, chemical, physico-chemical treatment, and thermal treatment;-Solidification, chemical fixation, encapsulation, pyrolysis and incineration.</p> <p>Biomedical wastes – Definition, categories, and management, E-waste: Sources and management</p>	8
II	<p>Disposal of Solid waste: sanitary land filling – site selection, design and operation of sanitary landfills – Leachate collection & treatment. Secure land filling.</p> <p>Incineration: Mass burn, Rotatory Kiln, Fluidized Bed incinerator, liquid injection incinerator, Waste gas flare incinerator, fixed grate incinerators, Plasma Pyrolysis. Composting, vermicomposting.</p>	8
III	<p>Principles of Industrial waste treatment - sources of pollution physical chemical, organic and biological properties. Manufacturing processes, flow sheets, characteristics and composition of wastes including waste reduction, treatment and disposal methods for Food Industries: Sugar, Fermentation, Material Industries: Paper, Steel - Metal - plating and petroleum refineries.</p>	7

IV	Role of Biotechnology in waste minimization; Recovery of by-products and raw material from wastewater conversion: waste recovery and reuse, reclamation by ground water recharge, agriculture reuse of effluent; sludge as fertilizer; biomass for energy, metal recovery, bioscrubbing. Biological Treatment Biological methods for waste processing: Biomethanation, Biodeisel, Biohydrogen.	7
V*	<ol style="list-style-type: none"> 1. To study about the various sources of solid waste generation in the locality. 2. To study about the categories of hazardous waste. 3. To study about the sanitary land fill management –case study 4. To estimate the BOD₅ and COD of the waste water. 5. To study about the working of Sewage treatment plant-case study. 	30
Suggested Evaluation Methods		
Internal Assessment: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> ● Class Participation: 04 marks ● Seminar/presentation/assignment/quiz/class test etc.: 04 marks ● Mid-Term Exam: 07 marks ➤ Practicum <ul style="list-style-type: none"> ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc.: 05 marks ● Mid-Term Exam: NA 		End Term Examination: Theory: 35 marks (Written exam) Practical: 20 marks (Demonstration/Viva-voce/Lab records etc)
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ol style="list-style-type: none"> 1. Crites R.W., Reed S.C and Bastion R. (2000). Land Treatment Systems for Municipal & Industrial Wastes. McGraw Hill Companies Inc. 2. Eckenfelder W.W. (1966). Industrial Water Pollution Control. McGraw Hill Publications. 3. Bhatia S.C. (2007). Solid and Hazardous Waste Management, Nice Printing Press, Delhi. 4. Singh, J.S., Singh, S.P and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi. 5. Sidwick J.M and Holdom R.S. (1987). Biotechnology waste treatment and exploitation, Ellis horwood limited, England. 		

*Applicable for courses having practical component.