॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun

E-mail: bos@srtmun

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० च्या अनुषंगाने शैक्षणिक वर्ष २०२३–२४ पासून संलग्न महाविद्यालये व विद्यापीठ संकुलांत पदव्युत्तर पदवी प्रथम वर्ष आणि विद्यापीठ संकुले व न्यू मॉडेल डिग्री कॉलेज मध्ये पदवी प्रथमवर्ष अभ्यासक्रम लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, शासन निर्णय क्र. एनईपी २०२०/प. क्र. ०९/विशि–३/शिकाना, दिनांक २० एप्रिल २०२३ व शासन पत्र. क्र एनईपी २०२०/प. क्र. ०९/विशि–३, दिनांक १६ जून २०२३ अन्वये सूचित केल्यानुसार राष्ट्रीय शैक्षणिक धोरण २०२०च्या अनुषंगाने दिलेल्या आराखडया नुसार दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीत ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार प्रस्तुत विद्यापीठाच्या विज्ञान व तंत्रज्ञान विद्याशाखा अंतर्गत खालील पदव्युत्तर पदवी अभ्यासक्रम (AICTE, PCI, BCI, CoA, NCTE) इ. सारख्या नियमक संस्थाची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) संलग्न महाविद्यालये, विद्यापीठ परिसर व उपपरिसर संकुलांमध्ये आणि पदवी प्रथम वर्ष अभ्यासक्रम विद्यापीठ परिसर व उपपरिसर संकुले व विद्यापीठ संचलित न्यू मॉडेल डिग्री कॉलेज, हिंगोली येथे शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

1) M.Sc. Bioinformatics (1st Year) – Sub-Campus School Latur
2) M.Sc. Mathematics (1st Year) – Campus School
3) M.Sc. Zoology (1st Year) - Campus School
4) M.Sc. Environmental Science (1st Year) –Campus School
5) M.Sc. Environmental Science (1st Year) - Affiliated colleges
6) M.Sc. Information Technology (1st Year) - Affiliated colleges
7) M.Sc. Software Engineering (1st Year) - Affiliated colleges

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी२०२०/S&T/अक/२०२३–२४/133

दिनांक : ०७.०७.२०२३.

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : १) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
१) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
२) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

STRUCTURE AND SYLLABUS OF TWO-YEAR MASTERS PROGRAM IN SCIENCE

(R-2023)

UNDER

NATIONAL EDUCATION POLICY (NEP 2020)

In

SUBJECT: ENVIRONMENTAL SCIENCE

FACULTY OF SCIENCE AND TECHNOLOGY

Program Code: SLS-S-ENV-PG

M. Sc. First Year

AFFILIATED COLLEGES

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

With Effect from June-2023

Preamble:

The National Education Policy 2020 (NEP 2020) is formulated to revamp education system and lay down road map for new India. This policy is framed based on the fundamental pillars of access, equity, quality, affordability, and accountability and seeks to transform India into a thriving knowledge society and a global knowledge superpower.

Some of the important features of National Education Policy are Increasing gross enrolment ratio in higher education, Holistic and multidisciplinary education with multiple entry/exit options, Establishment of academic bank of credit, Setting up of multidisciplinary education and research Universities and National Research Foundation, Expansion of open and distance learning to increase gross enrolment ratio, Internationalization of education, Motivated, energized and capable faculty, Online and digital education and Effective governance and leadership.

As per the National Education Policy, the Government of Maharashtra has proposed a model curriculum framework and an implementation plan for the State of Maharashtra. It is to suggest and facilitate the implementation of schemes and programs, which improve not only the level of academic excellence but also improve the academic and research environment in the state. The proposed curriculum framework endeavours to empower the students and help them in their pursuit for achieving overall excellence.

In view of NEP priority and in-keeping with its vision and mission, process of updating the curriculum is initiated and implemented in SRTM University at PG level from the academic year 2023-2024.

Keeping in mind, BOS in Environmental and Earth Science to make environment education an integral part of curriculum. Understanding the behaviour exhibited by organisms under some natural conditions. Educating and making students to aware of different environmental issues and problem. To prepares the students for their career working either in educational institutions or industries in which they can be directly involved in the teaching, research and development. Also, to ensure uniform curriculum and its quality at PG level, curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, Pollution Control Boards ,Different Environmental Consultancies and the UGC model curriculum are referred to serve as a base in updating the same

Salient Features:

The syllabus of M Sc Environmental Science has been framed to meet the requirement of Choice Based Credit System under NEP 2020. The courses offered here in will train and orient the students in the specific fields of Environments.

Apart from the Fundamental and applied Core Courses, the Department Specific Elective Courses deal with Indian Environment, Sustainable Agriculture & Organic Farming Disaster Management & Mitigation Habitat and Wildlife: Conservation &Management The Department Specific Elective Courses which include Skill Enhancement Courses like Water Recycling, Organic farming Technology, Rain Water Harvesting, Pollution Analytical Technique offered during this program are designed with the aim of imparting specific skills to the students which will lead to the self-employability through development of their own enterprises. This would help students to lay a strong foundation in the field of Environmental Science

The courses which deal with the environment, sustainability and ethics are Environmental Biotechnology, Disaster Management & Mitigation Habitat and Wildlife: Conservation &Management. These courses create awareness about conservation of biodiversity and its relevance with the socio-economic and environmental aspects. It also aims to make the students aware of bioethics, legislations and acts prevalent to control the degradation of our environment.

Overall, after completion of this program, students will acquire fundamental knowledge of applications in Environmental and also understand that Environmental Science is an integral part of the human life and developments

Program Educational Objectives:

The Objectives of this program are:

PEO1: To expose the students to the diversity amongst life forms.

PEO2: To make aware of natural resources and environment and the importance of conserving the same.

PEO3: To update curriculum by introducing recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC, and other competitive examinations successfully.

PEO4: To train and orient the students so as to develop human resource for the educational institutes, industries and other organizations.

PEO5: To develop specific skills amongst students for self-employability and also for the development of their own enterprises.

PEO6: To develop ability for the application of the acquired knowledge in the fields of life so as to make our country self-reliant and self-sufficient.

Program Outcomes:

The Outcomes of this program are:

PO1: This program will expose the students to the diversity amongst different life forms.

PO2: This program shall also make aware the students about natural resources and environment and the importance of conserving the same.

PO3: This will provide updated curriculum with recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop human resource for the educational institutes, industries and other organizations.

PO5: This will also develop specific skills amongst students for self-employability and also for the development of their own enterprises.

PO6: This shall develop ability in the students for the application of the acquired knowledge in the fields of life so as to make our country self-reliant and self-sufficient.

Program Specific Outcomes:

PSO1: This program will train and orient the students for job opportunities in Environmental Consultancy

PSO2: This program will also generate skilled human resource to serve in Environmental protection agencies

Prerequisite:

Basic knowledge of B. Sc. with Environmental Science as one of the optional subjects. The optional courses of this program are offered to the students registered for post-graduate programs. Such students should have the basic knowledge of Environment and willing to gain additional knowledge in the field of Environmental Science

The students seeking admission to this program should have cleared Science degree or B. Sc. with Environmental Science as one of the optional subjects with 24 credits.

Dr. Bhosle A.B.

Chairman, BOS in Environment and Earth Science

Swami Ramanand Teerth Marathwada University, Nanded.

(Email: bhoslearjunenvisci@gmail.com)

Details of the Board of Studies Members in the subject Environmental Science under the Faculty of Science & Technology, S.R.T.M. University, Nanded.

Dr. Arjun Bapurao Bhosle **Chairman** School of Earth Sciences, This University Mob	Dr. Vasant Madhav Wagh **Member** School of Earth Sciences, This University Mob
Dr. Sudhir Vishwambhar Shivanikar **Member** Netaji Subhashchandra Bose College, Nanded	Dr. Raju Kashinath Narkhede **Member** Maharashtra Udaygiri Mahavidyalaya, Udgir, Tq. Udgir Dist. Latur
Dr. Kedar Ramkrishna Solunke **Member** Indira Gandhi Senior College, CIDCO, Nanded	Dr. Vinod K Mukke **Member** Shivneri Mahavidyalaya, Shirur Anantpal, Tq. Shirur Anantpal Dist. Latur
Dr. Jayprakash Manoharrao Patwari **Member** Maharashtra Udaygiri Mahavidyalaya, Udgir, Tq. Udgir Dist. Latur	Dr. Rajkumar Govindrao Pawale **Member** Indira Gandhi Senior College, CIDCO, Nanded
Dr. Satish Sudhakarrao Patil **Member** Dr. B A Marathwada University, Aurangabad (Chh. Sambhajinagar)	Dr. Ravindra S Gavali **Member** Centre for Natural Resource Management, (CNRMCC & DM) National Institute of Rural Development & Panchayati Raj, Rajendra Nagar, Hyderabad
Dr. Pravin U Meshram **Member** Sevadal Mahila Mahavidyalaya & Research Academy, Sakkardara Square, Umrer Road, Nagpur- 440009	
As Per MPUA u/s 40(2)(d)(E Invitee Member	
Sonkamble Soloni Ramkishan (UG Student) C/o Maharashtra Udaygiri Mahavidyalaya, Udgir, Tq. Udgir Dist. Latur	Madiha Jabeen Gulam (PG Student) Netaji Subhashchandra Bose College, Nanded

Swami Ramanand Teerth Marathwada University, Nanded-431606

Faculty of Science & Technology

Credit Framework and Structure of Two Year PG Program (NEP 2020)

Subject: M. Sc. Environment and Earth Sciences (Affiliated Colleges) (R-2023)

Year & Level	Sem	Major Subject		RM	OJT / FP/CS (3-Cr)	Research Project	Practical (1-Cr)	Credits	Total Credits
		(DSC-4 Cr)	(DSE-3 Cr)						
1	1	SENVC-401 Environmental Biotechnology SENVC -402 Natural Resource Management SENVC -403 Environmental Analytical Techniques	SENVE-401 Indian Environment **OR** SENVE -403 Sustainable Agriculture & Organic Farming	SVECR-401 Research Methodology (3-Cr)	--		SENVP-401 Lab Course in Environmental Biotechnology SENVP-402 Lab Course in Natural Resource Management SENVP-403 Lab Course in Environmental Analytical Techniques SENVE-402 Lab Course in Indian Environment **OR** SENVE-404 Lab Course in Sustainable Agriculture & Organic Farming	22	44
	2	SENV C -451 Green Technology SENVC -452 Applied Microbiology SENVC -453 Current Environmental Issues	SENV E- 451 Disaster Management & Mitigation **OR** SENVE-453 Habitat and Wildlife: Conservation &Management	---	SBOTX -451 (O/F/C)	--	SENVP-451 Lab Course in Green Technology SENVP-452 Lab Course in Applied Microbiology SENVP-453 Lab Course in Current Environmental Issues SENVE-452 Lab Course in Disaster Management & Mitigation **OR** SBOTE-454 Lab Course in Habitat and Wildlife: Conservation &Management	22	
									44

DSE indicates Department Specific Elective Course. Environmental Science student in particular semester, can opt either of these courses OR a course offered by other programs of the School. DSC- Department Specific Core, OJT- On Job Training, FP- Field Project, CS- Case Study, RM- Research Methodology, Cr- Credit, VEC- Value Education Course, R- Revision, Credits of four semesters = 88, Total Marks of All Four Semesters = 2200

M. Sc. First Year Semester I (Level 6.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
Major	SENVC-401	Environmental Biotechnology	04	--	**04**	04	--
	SENVC-402	Natural Resource Management	04	--	**04**	04	--
	SENVC-403	Environmental Analytical Techniques	04	--	**04**	04	--
Elective (DSE)	SENVE-401 SENVE-403	Indian Environment Or Sustainable Agriculture & Organic Farming	03	--	**03**	03	--
Research Methodology	SVECR-401	Research Methodology	03	--	**03**	03	
DSC Practical	SENVP-401	Lab Course in Environmental Biotechnology	--	01	**01**	--	02
	SENVP-402	Lab Course in Natural Resource Management	--	01	**01**	--	02
	SENVP-403	Lab Course in Environmental Analytical Techniques	--	01	**01**	--	02
DSE Practical	SENVE-402 SENVE-404	Lab Course in Indian Environment **OR** Lab Course in Sustainable Agriculture & Organic Farming	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester I (Level 6.0)

Examination Scheme

[20% Continuous Assessment (CA) and 80% End Semester Assessment (ESA)]

Subject	Course Code	Course Name	Theory				Practical		Total Marks
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SENVC-401	Environmental Biotechnology	20	20	20	80	--	--	100
	SENVC-402	Natural Resource Management	20	20	20	80	--	--	100
	SENVC-403	Environmental Analytical Techniques	20	20	20	80	--	--	100
Elective (DSE)	SENVE-401 SENVE-403	Indian Environment Or Sustainable Agriculture & Organic Farming	15	15	15	60	--	--	75
Research Methodology	SVECR-401	Research Methodology	15	15	15	60	--	--	75
DSC Practical	SENVP-401	Lab Course in Environmental Biotechnology	--	--	--	--	05	20	25
	SENVP-402	Lab Course in Natural Resource Management	--	--	--	--	05	20	25
	SENVP-403	Lab Course in Environmental Analytical Techniques	--	--	--	--	05	20	25
DSE Practical	SENVE-402 SENVE-404	Lab Course in Indian Environment **OR** Lab Course in Sustainable Agriculture & Organic Farming	--	--	--	--	05	20	25

M. Sc. First Year Semester II (Level 6.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	**Practical**	**Total**	**Theory** (Hrs/Week)	**Practical** (Hrs/Week/Batch)
Major	SENVC-451	Green Technology	04	--	**04**	04	--
	SENVC-452	Applied Microbiology	04	--	**04**	04	--
	SENVC-453	Current Environmental Issues	04	--	**04**	04	--
Elective (DSE)	SENVE-451 SENVE-453	Disaster Management & Mitigation OR Habitat and Wildlife: Conservation &Management	03	--	**03**	03	--
On Job Training / Field Project / Case Study	SENVX-451	On Job Training (O) / Field Project (F) / Case Study (C)	--	03	**03**	--	03
DSC Practical	SENVP-451	Lab Course in Green Technology	--	01	**01**	--	02
	SENVP-452	Lab Course in Applied Microbiology	--	01	**01**	--	02
	SENVP-453	Lab Course Environmental Analytical Techniques	--	01	**01**	--	02
DSE Practical	SENVE-452 SENVE-454	Lab Course in Disaster Management & Mitigation **OR** Lab Course in Habitat and Wildlife: Conservation &Management	--	01	**01**	--	02
Total Credits			**15**	**07**	**22**	**15**	**11**

M. Sc. First Year Semester II (Level 6.0)

Examination Scheme

[20% Continuous Assessment (CA) and 80% End Semester Assessment (ESA)]

Subject	Course Code	Course Name	Theory				Practical		Total Marks
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SENVC-451	Green Technology	20	20	20	80	--	--	100
	SENVC-452	Applied Microbiology	20	20	20	80	--	--	100
	SENVC-453	Environmental Analytical Techniques	20	20	20	80	--	--	100
Elective (DSE)	SENVE-451 SENVE-453	Disaster Management & Mitigation OR Habitat and Wildlife: Conservation &Management	15	15	15	60	--	--	75
On Job Training / Field Project / Case Study	SENVX-451	On Job Training (O) / Field Project (F) / Case Study (C)	--	--	--	--	15	60	75
DSC Practical	SENVP-451	Lab Course in Green Technology	--	--	--	--	05	20	25
	SENVP-452	Lab Course in Applied Microbiology	--	--	--	--	05	20	25
	SENVP-453	Lab Course Environmental Analytical Techniques	--	--	--	--	05	20	25
DSE Practical	SENVE-452 SENVE-454	Lab Course in Disaster Management & Mitigation **OR** Lab Course in Habitat and Wildlife: Conservation &Management	--	--	--	--	05	20	25

SENVC-401: Environmental Biotechnology

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-401	Environmental Biotechnology	04	--	04	--	04

Teaching Scheme
Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2) /2		CA	ESA	
SENVC- 401	Environmental Biotechnology	20	20	20	80	--	--	100

Salient features of this Course:

Pre-requisite:

Knowledge about different kinds of pollution and their sources, different types of microbes, composition and decomposition of wastes.

Course Objectives:

This course aims to enable the students to gain in depth knowledge about the basics and uses of biotechnology in environmental science.

Course Outcomes:

On successful completion of the module, students should be capable of

1. Identifying the environmental problem and use the appropriate biosensors to identify it.
2. Identifying suitable biotechnological solution to the environmental problem using a suitable bio tool.
3. Using bioremediation techniques to abate environmental problem.

Course Content:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction to Biotechnology**	**15**
	1.1	Definition and scope of biotechnology, biological treatment, Biotechnological approach of environmental pollution abatement using Bio tools, Environmental Biotechnology Introduction and scope of Environmental biotechnology,	
	1.2	Environmental and biotechnological management with biosensors.	
	1.3	Importance of microorganism and their growth, Biotechnological approach of environmental pollution abatement, Biodegradation of pollutants.	
	1.4	Biological treatment, Factors impacting Bio-treatment	
2.0		**Unit-II: Applications of Biotechnology**	**15**
	2.1	Bio tools and Applications Biotechnological approach of energy management, Biomass, Biogas generation and its significance in waste recycling,	
	2.2	Factors affecting biogas yield, Advantages and disadvantages. Biofuels: Bio-ethanol, Bio-diesel, Bio-hydrogen, Bio-fertilizer: bacteria and fungi.	
	2.3	Natural composting, Vermi-composting and Earthworm technology	
	2.4	Use of surface worms, Typical Vermiculture plant, Maintenance and limitations of vermi composting, Merits and demerits.	
3.0		**Unit-III: Techniques in Biotechnology**	**15**
	3.1	Biosensors and Uses 40 Biosensors and environmental pollutants, Biochemical Oxygen Demand sensors, Ammonia sensors, Nitrate sensors, Sulphate ion sensors, its advantages and disadvantages.	
	3.2	Bioreactors and its scope, Biological filters, Rotating biological contractors (RBC) merits and demerits, Fluidized bed reactors.	
	3.3	Inverse fluidized bed bio-film reactor (IFBBR), Expanded bed reactor (EBR), Contact digester, Packed bed reactors (PCR).	

	3.4	Up-flow anaerobic sludge blanket reactors (UASB), Periodic biological Sequencing batch reactor (SBR), Membrane bioreactor.	
4.0		**Unit-IV: Bioremediation and Bio reclamation**	**15**
	4.1	Bioremediation and Reclamation Bioremediation.	
	4.2	Types of bioremediations., Reduction of herbicides, pesticides and fertilizers.	
	4.3	Bio-remedial applications, Toxic site reclamation, Removal of spilled oil and grease deposits.	
	4.4.	Biodegradation of xenobiotic, toxic organics, Phenols as pollutants.	
		Total	**60**

Reference Books

01. Environmental Biotechnology: S. N. Jogdand, Himalaya Publishing House, Mumbai, 2006

02. A Textbook of Biotechnology: R. C. Dubey, S. Chand & Company, New Delhi, 2002

03. A textbook of Environmental Chemistry & Pollution Control: S S Dara, S. Chand & Company, New Delhi, 2002

04. A textbook of Environmental Studies: G R Chatwal & Harish Sharma, Himalaya Publication House, New Delhi, 2004

05. Environment & Biotechnology: B.P. Singh, H. N. Verma & K. M. Srivastava, Today & Tomorrows & Publishers, New Delhi, 1988

06. Industrial Biotechnology (Problems & remedies): Indu shekhar Thakur, I. K. International Pvt. Ltd., New Delhi, 2006

07. Introduction to Environmental Biotechnology: A. K Chatterji, PHI learning Pvt. Lim., New Delhi, 2000.

SENVP-401: Practical based on SENVC-401

1. Collection and preservation of water and soil samples
2. Determine the pH of soil samples
3. Determine the Electric Conductivity of various samples
4. To study the air fungi by PDA preparation
5. To study the bacteria by NA preparation method
6. To determine the organic matter content from the soil samples
7. To Estimate the efficiency of biofertilizers
8. Study the Azotobacter from soil samples

SENVC-402: Natural Resource Management

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-402	Natural Resource Management	04	--	04	--	04

Teaching Scheme
Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA	CA	ESA	
		Test I	Test II	Avg of (T1+T2) /2				
SENVC-402	Natural Resource Management	20	20	20	80	--	--	100

Course pre-requisite:

1. Students should be aware about Natural Resources and its types and their natural , regional and global status

Course objectives:

The nature of Earth's resources, their generation, extraction and impact of human activities on earth's environment. And expected to understand effective management strategies. It aims to provide an idea of effective management strategies and a critical insight of the major sustainability issues.

Course outcomes: Students will be able to

1) Acquire knowledge about the various natural resources, their uses and management
2) Understand the importance of resource management to achieve the goals of sustainability
3) Application of resource management practices for planning and decision making
4) Provide opportunity to think on linkage between resources in environment and process of development

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction to Natural Resources**	**15**
	1.1	Definition, Introduction, Classification, renewable and non-renewable resources; Depletion of Natural Resource-Causes.	
	1.2	Impacts and mitigation measures and Importance of Natural resources.	
	1.3	Limitations of non-renewable resources; Limitations of renewable resources.	
	1.4	Man and the global resources. Human life, Role of Individual in Natural resource management.	
2.0		**Unit-II: Energy and Resources**	**15**
	2.1	**Conventional Energy resources**: Coal, Oil, Petroleum and natural gas**,** Nuclear energy, Nuclear fission, Energy released in nuclear fission; Nuclear fuel Uranium, Nuclear power and the Environment Petroleum: Extraction of crude oil, Environmental effects.	
	2.2	Coal: Origin of coal, Composition of coal, Types of coal, Uses of Coal, Coal and the Environment; Energy Scenario in India, Uses and Management of Conventional Energy resources.	
	2.3	**Non-Conventional Energy resources:** Solar energy, Hydro energy, Tidal energy, Biomass energy, Wind energy, geothermal energy, Uses and Management of Non-Conventional Energy resources. Energy resources options and limitations, Indian renewable energy program.	
	2.4	**Mineral Resources**: Definition, Minerals in India Iron, Manganese, Bauxite, Copper, Gold, Uses of Minerals, Management of Minerals.	
3.0		**Unit-III: Biotic Resources**	**15**
	3.1	**Forest resources**: Uses of forest resources, wood products, wood consumption, wood demand, Non wood products, trade of forest products, Forest and Environment, deforestation, afforestation, Social	

		forestry, Medicinal forestry and their significance, Forest management.	
	3.2	**Forest resources**: Uses of forest resources, wood products, wood consumption, wood demand, Non wood products, trade of forest products, Forest and Environment, deforestation, afforestation, Social forestry, Medicinal forestry and their significance, Forest management.	
	3.3	**Biofuel**: Classes of biofuel, Sources of biofuel, Production of biofuel, Ethanol. Biodiesel.	
	3.4	National forest policy. Wildlife resources: wildlife and environment, endangered species, causes of depletion of Wildlife, wildlife trade; Uses of wildlife (positive value and negative value), wild life conservation and management.	
4.0		**Unit-IV: Environmental Policies**	**15**
	4.1	Principles and Objectives of the National Environment Policy in India.	
	4.2	Global Environmental Policies and National Strategies for Protection of Environmental Quality.	
	4.3	Agenda 21 of Earth Summit, Major International Organizations and Agencies Involved in Environmental Management.	
	4.4	National Environmental Policy and its Practices; Role of Civil Society and private sector in the implementation of the environment policy.	
		Total	**60**

References Books

1) Principles of Ecology:P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
2) Environmental Management:Sandeep Joshi (shrishti Eco – Research Institute, Pune)
3) Environmental Biology:P. D. sharma (Rastogi Publications, Meerut)
4) Ecology and Environment:P. D. sharma (Rastogi Publications, Meerut)
5) Principles of Environmental Biology:P. K. G. Nair (Himalaya Publishing House, New Delhi.
6) Environmental Biology:M. P. Arora (Himalaya Publishing House, New Delhi)
7) Environmental Science:Enger Smith, Smith, W. M. C. Brown (Company Publishing)
8) Introduction to Environmental Studies:Turk & Turk
9) Conservation of Natural resources: David A. Castillan
10) Fundamentals of Environmental Science: G. S. Dahliwal, G. S. Sangha, P. K. Ralhan, Kalyani Publishers, New Delhi
11) Environmental chemistry: B. K. Sharma (Goel publishing house, Meerut)
12) Environmental Science:Enger Smith, Smith, W. M. C. Brown (Company Publishing)
13) Forests in India: V. P. Agrawal Oxford & IBH Publishing company Pvt. Ltd., New Delhi), 1988
14) Plant ecology and Soil Science: R. S. Shukla, P. S.Chandel , (S. Chand and company Ltd., New Delhi), 2001.
15) Textbook of Environmental Studies for Undergraduate Courses: Erach Bharucha (Universities Press), 2013.
16) Introduction to Environmental Science:Y. Anjaneyulu (B.S. Publication), 2008.
17) Environmental Science: UGC NET/SET (Danika Publishing Company), 2

SENVP-402 Practical's based on SENVC-402

1. To compare the efficiency of different solar energy conversion devices
2. To estimate the tidal energy power for wind force
3. Determination of Surface Tension of a Liquid - Capillary tube method
4. Study on solar photovoltaic panel in parallel combination
5. Performance testing of solar cooker
6. Estimation of wind speed using anemometer
7. Determination of efficiency of DC-AC inverter and DC-DC converters
8. Measurement of efficiency of solar flat plate collector
9. Estimation of power requirements of a house/institute.
10. Study on solar photovoltaic panel in series combination.

SENVC-403: Environmental Analytical Techniques

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-403	Environmental Analytical Techniques	04	--	04	--	04

Teaching Scheme
Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2) /2		CA	ESA	
SENVC-403	Environmental Analytical Techniques	20	20	20	80	--	--	100

Course pre-requisite:

This course may opt by M.Sc. students from Environmental Science subject to understand the different Analytical techniques this will help to students for accuracy, precision and interpretation of results in best way.

Course objectives:

- The aim of this paper is to provide skills and an improved understanding of Analytical techniques and its use in environmental analysis.
- To know the Analytical techniques and instrumentation operations.
- To study the different instrumentation in analysis of Air, Water and Soil analysis.

Course outcomes:

- Students will know advance instrumentation techniques.
- Students can be able to understand the precision and accuracy in different instrumentation techniques.
- Students are able to think critically and use of these analytical techniques in research and daily analysis of data.

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction and sampling technique**	**15**
	1.1	Sample preparation, Preservation and Processing of Air, Water and Soil samples.	
	1.2	Sampling equipment's, Separation and sampling techniques, Precipitation, Fractional crystallization, Fractional distillation, Solvent extraction	
	1.3	Theory and applications of High-volume air sampler (HVAS) construction, Respirable Suspended Particulate Matter Sampler (RSPM), measurement and its scope.	
	1.4	Suspended Particulate Matter Sampler (SPM) analytical significance, Particulate Matter (PM), its measurement and practical importance, Anderson, Tilak Air Sampler.	
2.0		**Unit-II: Meteorological Instrumentation**	**15**
	2.1	Pressure measurement: Principle, Barometer, Operation and measurement; Temperature measurement: Principle, Types of thermometers, Operation and measurement.	
	2.2	Turbidity measurement: Principle, Operation and measurement; Manometer: Principle, Operation, and measurement; Piezometer: Principle, Operation and measurement	
	2.3	Pyrometer: Principle, Operation and measurement.	
	2.4	Rain gauges: Types: Recording type rain gauge, Non recording type rain gauge, Ventury meter: Principle, Operation and measurement;	
3.0		**Unit-III: Techniques in Biotechnology**	**15**
	3.1	Principles, Methods and applications of Thin Layer Chromatography (TLC).	
	3.2	working and applications; Column chromatography: working and applications	
	3.3	Gas chromatography (GC): working and applications; Gas-liquid chromatography (GLC): working and applications	

	3.4	**High performance liquid chromatography (HPLC):** working and applications; Ion exchange chromatography: working and applications.	
4.0		**Unit-IV: Spectrophotometry**	**15**
	4.1	Basic concepts in spectrophotometry, Principle and Operation of Spectrophotometer, Ultra Violet (UV) Spectrophotometer: working and applications.	
	4.2	Infra-Red (IR) Spectrophotometer: working and applications Nuclear Magnetic Resonance (NMR): working and applications; Atomic Absorption Spectrophotometer (AAS): working, applications and its importance	
	4.3	Flame Photometer: working and applications; Fluoride meter: utility and significance.	
	4.4	Conductivity meter: Working and applications; Nephalo turbidity meter: working and utility; pH meter: working and applications.	
		Total	**60**

References Books:

1) Standard Methods for the Examination of Water and Wastewater: (APHA, AWWA & WPCF), 1985.
2) Instrumental Analysis: Shoog Holler (Harcourt Asia Publishers Ltd., New Delhi), 1952.
3) Instrumental Methods of chemical Analysis: Chatwal and Anand (Himalaya Publishing House, New Delhi), 1994.
4) Analytical Instrumentation Handbook" by Jack Cazes and Jack Cazes, 3 rd edition Taylor and Francis group.
5) Environmental Instrumentation and Analysis Handbook by Randy D. Down P.E., Jay H. LehrJohn Willey and Sons 2004.
6) Instrumentation Reference Book 4th edition November 25, 2009, Walt Boyes Elsevier Publication.
7) Instrumental Methods of Analysis: Willered Merit and Dean (CBS Publication, New Delhi)
8) Instrumental Methods of Environmental Analysis: Karan Sareen, (Sarup ans Sons Publishers, New Delhi), 2001.
9) Instrumental Methods of Chemical Analysis: B. K. Sharma, Goel Publishing House, Meerut (1996).
10) Instrumental Methods and chemical Analysis: H. Kaur, Pragati Prakashan, Merrut (2009). 67.

11) Instrumental Analysis: Gurdeep Chatwal (Himalaya Publishing House, New Delhi), 2000 9. 6.Instrumental Methods: V. B. Borade (Nirali Prakashan, Mumbai)
12) 12.Instrumental Analysis for science and technology: W. Ferren (Agrobios India, Jodhpur)

SENVP-403 Practicals based on SENVC-403

1. To study the air pollution equipment's HVAS
2. Estimate the dust fall by High Volume Air Sampler method
3. Estimation of sodium by flame photometer of given samples
4. Estimation of potassium by flame photometer of given samples
5. Evaluate the turbidity from water sample by Nephalo-Turbidity method
6. Determination of residual chloride from different samples
7. Determine the chlorophyll pigment by chromatography
8. Estimation of COD from industrial effluents
9. Estimation of BOD from industrial effluents

SENVE-401: INDIAN ENVIRONMENT

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVE-401	**INDIAN ENVIRONMENT**	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA	CA	ESA	
		Test I	Test II	Avg of (T1+T2) /2				
SENVE-401	**INDIAN ENVIRONMENT**	15	15	15	60	--	--	75

Salient features of this course:

Indian environment is diverse ecological system, comprising of Glaciers, Marine, Riverine, Forest, Grassland, Terrestrial, Mountains, Desert, Brackish as well as Wetland respectively. Indian environment study deals with the status of abiotic and biotic factors and its interactions so our emphasis of this course is to propagate this huge biodiversity system. It included diversity of organisms in an environment, interactions among individuals within a population, and interactions among species.

Pre-requisites:

The aim of this module is to provide an understanding of (i) Indian environment and the various factors influencing the biodiversity and all. (ii) Impacts of several climate change factors will help for the planning and conservation methods.

Course Objectives:

1. To understand the fundamental concepts of environment in concern with Indian climate and the widely distributed abiotic and biotic resources.

2. Demonstrate an understanding of the application of environmental resources includes air, water, soil, vegetation, agriculture etc.

3. To study meticulously from minor to major resources with the information about species ecosystem and its environment, with an emphasis on Its need in maintaining environmental balance.

Course Outcomes:

1. Appreciation of the need for both a multi-disciplinary and an interdisciplinary approach in advancing knowledge and understanding of Environment, Ecology, Aquatic species and the climate.

2. Knowing of the processes which shape the natural healthy ecosystem at different temporal and spatial levels, provides the information about diverse resources.

3. Understanding of the contribution of individual biotic species and its scope for the society in keeping local and global environment balance for better human life with deep study of global climate change impact and preparedness.

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction to climate**	**15**
	1.1	Climate of India, precipitation, monsoon, influence of climate factors on ecological systems,	
	1.2	Impact study on aquatic flora and fauna, Indian vegetation, forest, agriculture system, role of rivers in overall development of Indian sectors	
	1.3	Global warming, climate change role and mitigation, wildlife species conservation, environmental laws implementation of air, water, national forest policy, biodiversity act., wild-life protection act.	
	1.4	Importance of social forestry, industrial forestry, medicinal forestry, afforestation, causes of deforestation, flood control methods, water recharge techniques, national environmental policies, and environmental researches, use of RS and GIS in environmental resources study.	
2.0		**Unit-II: Biosphere**	**15**
	2.1	Atmosphere, water cycle, lithosphere, hydrosphere, perennial and non-perennial rivers in India, role of major projects/dams in development of electricity, industries and agriculture, biotic communities.	
	2.2	Water conservation, rainwater harvesting methods and its implementation, ground water storage.	
	2.3	Wide awareness programs/projects, role of Governmental and NGO ‘s agencies in maintenance of environmental resources.	
	2.4	Chipko movement and other, people’s participations in protecting vegetation/forest, climate change impact on water bodies and wetland ecosystems, eco-friendly works/projects.	
3.0		**Unit-III: Sustainable development**	**15**
	3.1	Ecology and ecological characteristics, perspectives, freshwater and marine ecosystems and its resources,	

		impact of air, water pollutants on surrounding environment.	
	3.2	Mitigation of various pollution sources in relation to local environment, environmental related projects on biodiversity, biodiversity conservation, Global agreements and national concerns, Swachh Bharat Abhiyan, Clean India.	
	3.3	Green India project, energy and environmental strategies in India, non-conventional energy resources utilization project implementation.	
	3.4	Biomass, biogas energy generation project and distribution system, composting and waste recycling techniques, national river purification projects. Sustainable development.	
		Total	**45**

Reference Books

1) Mills, D.H. (1972) an introduction to freshwater Ecology. Liver & Boyd, Edinburg
2) Das, S.M. (1989) Hand book on Limnology & Water Pollution. South Asian Publishers, New Delhi.
3) Verma & Agarwal (1995) Environmental Biology (Principles of Ecology) Chand & Co, New Delhi.
4) S C Santra, Environmental Science.
5) Chokkan, K.B., Pandya, H. and Raghunathan, H. (Eds). 2004. Understanding Environment. Sagar publication India Pvt. Ltd., New Delhi 18.
6) Harper, C., Harper, C.L. and Snowden, M. 2017. Environment and Society: Human Perspectives on Environmental Issues.
7) Hukkinen, J.I. 2012. Social networks and natural resource management: uncovering the social fabric of environmental governance.
8) Kumar, M. 2014. Adaptations to Climatic Variability: Irrigation, and Settlements patterns in Early Medieval Rajasthan,
9) Rangarajan, M. and Sivaramakrishnan, K.2012. India‘s Environmental History (2 Vols.)

SENVE-402 Practicals based on SENVE-401

1. Determine the water quality index
2. Study the water sampling equipment's and their uses
3. Determine the pH of various water samples
4. Determine the plankton study from the collected samples
5. Determine the Dissolved oxygen by Winkler's method
6. Determine the Alkalinity of collected samples
7. Visit the Wetland for diversity of birds study
8. Field visit to natural water bodies for observation of flora and fauna

SENVE-403: SUSTAINABLE AGRICULTURE AND ORGANIC FARMING

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVE-403	**SUSTAINABLE AGRICULTURE AND ORGANIC FARMING**	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2) /2		CA	ESA	
SENVE-403	**SUSTAINABLE AGRICULTURE AND ORGANIC FARMING**	15	15	15	60	--	--	75

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction to Sustainable Agriculture**	**15**
	1.1	Definitions, Sustainability concepts, pre and post green revolution in India, Monocultures in crop and livestock production, sustainable agricultural concepts and concerns in India and on global platform; Public policies, Biodiversity issues, Organic agricultural production, Low Input Sustainable Agriculture (LISA); Sustainable Agriculture Research and Education (SARE); Agro-Ecology.	
	1.2	Creating stakeholders for sustainable agriculture; Agronomy, Nutrient management, Weed control, Insect control, Water quality, Livestock production.	
	1.3	Societal traders and institutions, Economic stakes, National Security - Food Production at Stake, Domestic livestock ecosystems, Agro pastoralism.	
	1.4	The role of grazing herbivores in sustainable systems. Intensive v Extensive livestock keeping. Holistic Resource Management, Energy conversion, marketing.	
2.0		**Unit-II: Organic Farming**	**15**
	2.1	A) Definition, Components, benefits and Comparison with Conventional methods. Principles of Organic Farming: Healthy soil biota, On-farm biodiversity, Mixed cropping, Green manuring, Growing trap crops, Use of Jeevamrut, Use of FYM/Compost/Vermicompost, In-situ irrigation, Use of improved or straight-line varieties and integration of agriculture with livestock.	
	2.2	**B)** Nutrient Management: Use of organic manures, vermicompost, green manuring crops and biofertilizers. **C)** Pest and disease management: Use of biocontrol agents, biopesticides, pheromone traps, bird perches and trap crops.	
	2.3	**D)** Weed management	

		E) Water management: In-situ irrigation	
	2.4	**F) Pre-harvest and Post-harvest management:** Quality assessment, grading, processing, labelling and packaging.	
3.0		**Unit-III: Organic Certification**	**15**
	3.1	a) Procedures and policies, Certification bodies: National and International, Audit, Traceability. b) Product quality and accreditation: Product analysis, methods of quality testing, residual limits for hazardous chemicals and metals.	
	3.2	c) Marketing: National and International markets, export policies and regulations, taxation, traders and institutions.	
	3.3	d) Water management: In-situ irrigation	
	3.4	e) Pre-harvest and Post-harvest management: Quality assessment, grading, processing, labelling and packaging.	
		Total	**45**

Reference Books

1) Horne, Paul Anthony (2008). Integrated pest management for crops and pastures. CSIRO Publishing.
2) ISBN 978-0-643-09257-0 2. Vogt G (2007). Lockeretz W, ed. Chapter 1: The Origins of Organic Farming. Organic Farming: An International History. CABI Publishing. pp. 9–30. ISBN 9780851998336
3) Pamela Ronald; Raoul Admachak (April 2008). "Tomorrow's Table: Organic Farming, Genetics and the Future of Food". Oxford University Press. ISBN 0195301757.
4) Halberg, Niels (2006). Global development of organic agriculture: challenges and prospects. CABI. p. 297. ISBN 978-1-84593-078-3
5) Organic Agriculture: Sustainabiblity, Markets and Policies. OECD. 1 January 2003. ISBN 978-92-64-10150-0.
6) Martin, K. A. "State to switch fully to organic farming by 2016". Mohanan.
7) Blair, Robert. (2012). Organic Production and Food Quality: A Down to Earth Analysis. Wiley-Blackwell, Oxford, UK. ISBN 978-0-8138-1217-5.

SENVE-404 Practicals based on SENVE-403

1. To collect the soil samples for laboratorial study
2. To determine the organic matter content from the soil samples
3. To determine the water holding capacity of soil samples
4. To determine the pH of different soil samples
5. To determine the soil salinity
6. Determination of Soil Bulk Density
7. Estimation of soil bacterium
8. Estimation of soil fungi and microbes

SVECR-401 Research Methodology

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SVECR-401	Research Methodology	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SVECR-401	Research Methodology	15	15	15	60	--	--	75

Course pre-requisite:

1. Basic knowledge of Biology and a strong foundation in biological sciences, including Molecular Biology, Genetics, and Biochemistry.

Course objectives:

2. To familiarize students with the principles and concepts of research methodology in the field of Botany and other Biological Sciences.
3. To develop critical thinking and analytical skills necessary for designing research experiments, formulating research questions, and selecting appropriate methodologies.
4. To enhance students' understanding of various research methodologies, including experimental design, data collection and analysis, statistical methods, and literature review.
5. To equip students with the necessary skills to plan and execute research projects, including ethical considerations, data interpretation, and effective communication of research findings.

Course outcomes: Students will be able to

6. Demonstrate a comprehensive understanding of the principles and significance of research methodology in Botany and other Biological Sciences, including the ability to critically evaluate scientific literature and identify research gaps.
7. Apply appropriate experimental design and statistical methods for data collection and analysis, and effectively interpret research results.
8. Develop skills in planning and executing research projects, including the ability to formulate research questions, select and apply appropriate research methodologies, and manage research timelines and resources.
9. Communicate research findings effectively through written reports, presentations, and

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction to Research Methodology**	**11**
	1.1	Definition and nature of research; Types of research (basic, applied, quantitative, qualitative, mixed methods).	
	1.2	Research process (problem identification, research design interpretation, and reporting).	
	1.3	Data analysis, interpretation, and reporting).	
	1.4	Research ethics and Plagiarism, Literature review and referencing.	
2.0		**Unit-II: Research Design and Data Collection**	**11**
	2.1	Research problem and hypothesis formulation; Sampling techniques and sample size determination	
	2.2	Data collection methods (observation, interview, questionnaire, survey, case study, experimental, and archival research).	
	2.3	Research instruments (questionnaire, interview schedule, observation checklist).	
	2.4	Reliability and validity of research instruments.	
3.0		**Unit-III: Data Analysis and Interpretation**	**12**
	3.1	Data editing, coding, and entry.	
	3.2	Descriptive statistics (measures of central tendency, variability, and correlation).	
	3.3	Inferential statistics (hypothesis testing, t-test, ANOVA, regression analysis, chi-square test).	
	4.4	Qualitative data analysis (content analysis, thematic analysis, discourse analysis), Interpretation of research findings.	
4.0		**Unit-IV: Scientific Writing and Communication**	**11**
	4.1	Research report writing (structure, format, and style).	
	4.2	Citation and referencing (APA, MLA, Harvard, etc.).	
	4.3	Writing research proposals and abstracts.	
	4.4	Presentation skills (oral and poster presentations), Publication, ethics and peer review.	
		Total	**45**

Reference Books

1. Kumar R (2018) Research Methodology: A Step-by-Step Guide for Beginners, SAGE Publication, California, USA.
2. Kothari CR, Garg G (2019) Research Methodology: Methods and Techniques, New Age International Publishers, India.
3. Kumar U, Dubey B, Kothari DP (2022) Research Methodology, Techniques and Trends, Chapman and Hall/CRC, New York.
4. Frankfort-Nachmias C, Nachmias, D (1996) Research Methods in the Social Sciences. St. Martin's Press, New York.
5. Creswell JD, Creswell JW (2017) Research Design: Qualitative, Quantitative and Mixed Methods Approaches, SAGE Publication, California.

SEMESTER II

M. Sc. First Year Semester II (Level 6.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/Week)	Practical (Hrs/Week/Batch)
Major	SENVC-451	Green Technology	04	--	**04**	04	--
	SENVC-452	Applied Microbiology	04	--	**04**	04	--
	SENVC-453	Environmental Analytical Techniques	04	--	**04**	04	--
Elective (DSE)	SENVE-451 SENVE-453	Disaster Management & Mitigation OR Habitat and Wildlife: Conservation &Management	03	--	**03**	03	--
On Job Training / Field Project / Case Study	SENVX-451	On Job Training (O) / Field Project (F) / Case Study (C)	--	03	**03**	--	03
DSC Practical	SENVP-451	Lab Course in Green Technology	--	01	**01**	--	02
	SENVP-452	Lab Course in Applied Microbiology	--	01	**01**	--	02
	SENVP-453	Lab Course Environmental Analytical Techniques	--	01	**01**	--	02
DSE Practical	SENVE-452 SENVE-454	Lab Course in Disaster Management & Mitigation **OR** Lab Course in Habitat and Wildlife: Conservation &Management	--	01	**01**	--	02
Total Credits			**15**	**07**	**22**	**15**	**11**

M. Sc. First Year Semester II (Level 6.0)

Examination Scheme

[20% Continuous Assessment (CA) and 80% End Semester Assessment (ESA)]

Subject	Course Code	Course Name	Theory				Practical		Total Marks
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SENVC-451	Green Technology	20	20	20	80	--	--	100
	SENVC-452	Applied Microbiology	20	20	20	80	--	--	100
	SENVC-453	Current Environmental Issues	20	20	20	80	--	--	100
Elective (DSE)	SENVE-451 SENVE-453	Disaster Management & Mitigation OR Habitat and Wildlife: Conservation &Management	15	15	15	60	--	--	75
On Job Training / Field Project / Case Study	SENVX-451	On Job Training (O) / Field Project (F) / Case Study (C)	--	--	--	--	15	60	75
DSC Practical	SENVP-451	Lab Course in Green Technology	--	--	--	--	05	20	25
	SENVP-452	Lab Course in Applied Microbiology	--	--	--	--	05	20	25
	SENVP-453	Lab Course Environmental Analytical Techniques	--	--	--	--	05	20	25
DSE Practical	SENVE-452 SENVE-454	Lab Course in Disaster Management & Mitigation **OR** Lab Course in Habitat and Wildlife: Conservation &Management	--	--	--	--	05	20	25

SENVC-451: Green Technology

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-451	**Green Technology**	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA	CA	ESA	
		Test I	Test II	Avg of (T1+T2) /2				
SENVC-451	**Green Technology**	20	20	20	80	--	--	100

Course objectives

Students will be able to know:

1) The concept and application of green chemistry for minimization of wastes and environmentally balanced industrial complexes.
2) To design green products to maintain quality, predictability, functionality, and upgradability in order to improve performance of the products, in environment.
3) The application of green nanotechnology, carbon nanotubes, green nano particles, and biocompatibility for resource conservation, ecosystems, non-medical applications and human beings.
4) The use of green chemistry in industries, fuel cells, solar energy, electric vehicles, solar photovoltaic technology and in biofuel production etc.

Course Outcome

Students should be able to:

1) Define the concept and application of green chemistry for minimization of wastes and environmentally balanced industrial complexes.
2) Design green products to maintain quality predictability, functionality and upgradability to improve

performance of the products in environment.

3) Apply the concept of green nanotechnology, carbon nano tubes, green nano particles and biocompatibility for resource conservation, ecosystems, non-medical applications and human beings.
4) Choose the applications of green chemistry in industries, fuel cell, and solar photovoltaic technology and in biofuel product etc.

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Overview, Principle, concepts and tools of Green Technology**	**15**
	1.1	Overview of green chemistry, chemistry of the atmosphere, principles of sustainable and green chemistry.	
	1.2	basic principles of green technology, concepts of atom economy and carbon trading, tools of green technology.	
	1.3	concepts of atom economy and carbon trading, tools of green technology.	
	1.4	waste minimization and climate change, zero waste technology, concept of environmentally balanced industrial complexing and industrial ecology.	
2.0		**Unit-II: Green Product Design**	**15**
	2.1	Green product design definition, product strategy, life cycle of product, ISO 14000, environmental load of product, material selection, resources use, production requirements and planning for the final disposition (recycling, reuse or disposal) of a product.	
	2.2	integration with existing product design approaches such as quality, producibility, and functionality, upgradability, disassembly.	
	2.3	Greening supplier inputs, improving whole systems, international was on take-back laws, extended responsibility.	
	2.4	eco-labeling examples from pharmaceuticals, foods, cosmetics, packaging, computers, polymer, automobiles, electronics industry.	
3.0		**Unit-III: Techniques in Biotechnology**	**15**
	3.1	Introduction to Nanomaterials and green nanotechnology, fullerene, carbon nanotubes, nanoparticles.	
	3.2	Green nanoparticle production and characterization, biocompatibility	
	3.3	Nanomedical applications of green nanotechnologies.	
	4.4	Use of nanotechnologies and materials impact on biodiversity, resources conservation, ecosystems and human.	

4.0		**Unit-IV: Green technology applications**	
	4.1	Biocatalysts, green chemistry in industries, fuel cell and electric vehicles, solar energy and hydrogen production, energy from alternate sources, solar photovoltaic technology, biofuel production (bioethanol and biodiesel), biomass, prevention/minimization of hazardous /toxic products.	**15**
	4.2	Agricultural related practices and food processing, production of biodegradable materials, concept of green building, pollution free engineering process; Separation technique for removal and recovery of pollutants.	
	4.3	Socio-economic aspects recovery waste as abatement, end of pipe solutions, life cycle analysis of plastics, palters, tins, identification of waste streams from process, waste minimization strategies, prioritizing pollution prevention options.	
	4.4	Selecting environmentally compatible materials, design of unit operation for pollution prevention, economics of pollution prevention, process flow sheeting for pollution prevention.	
		Total	**60**

Reference Books

1. M.H. Fulekar (2010) Nanotechnology Importance and application, I K international publishing house Pvt. Ltd.
2. Lynn goldman, Cristine Coussens, Implications of nanotechnology for environmental health research < National Academic Press, Washington, 2007.
3. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker: New York, 2001.
4. Anastas ,P.T.Warner,, J.C. Green chemistry : theory and Practice. Oxford Univ.Press : oxford,I998.
5. Lynn E.Foster : Nanotechnology : Science, Innovation , and Opportunity, December 21, 2005, Prentice Hall.
6. Fei wang &AkhleshLakhatakia (eds) (2006). Selected Papers on Nanotechnology- Theory & Modeling °Milestone Volume 182. SPIE Press.
7. Caye Drapcho, NhauanPhu Nghiem, Terry Walker (2008). Biofuels Engineering Process Technology. (McGraw-Hill).
8. AkhleshLakhtakia (ed) (2004). The handbook of Nanotechnology, Nanometer structures Theory, Modeling and Simulation. SPIE Press, Bellingham, WA, USA.
9. Rebecca L. Lankey, Paul T.Anastas, "Advancing Sustainability through Green Chemistry and Engineering"(ACS Symposium Series)
10. Dr. Satish Patil, (2020) Green Economy, International Publications, Kanpur (ISBN 978-81-945988-9-3).
11. Dr, Satish Patil, Geetanjali Kaushik, Arvind Chel & Shivani Chaturvedi, Biofuels: Advances and Prespectives (2018), Stadium Press India pvt.Lt.(ISBN 93-85046-22-5)
12. Varma, R,S,Advances in Green Chemistry : Chemical Syntheses using Microwave Irradiation, Kavitha printers: Bangalore, india,2002.
13. Martin Charter and Ursula Tischner Sustainable solution: Developing products and series for the future Greenleaf Publishing.
14. Lancaster, M. Green Chemistry: An Introductory Text, Royal Society of Chemistry: Cambridge, 2002.
15. Allent, D.T. and D.R.Shonnard, Green Enginnering: Environmentally conscious desing of Chemical processes, Prentice hall PTR : Upper Saddle River, NJ, 2001.
16. Matlack. A.S. Introduction to Green Chemistry marcel Dekker: New York, NY, 2001.

SENVP-451 Practicals based on SENVC-451

1. Determine the pH of various soil samples
2. Estimate the Sulphate by spectrophotometer
3. Determine the Dissolved oxygen by Winkler's method
4. Determine the Alkalinity of collected samples
5. Evaluate the Chloride from water sample by titrimetric method
6. Determination of phosphate by spectrophotometer
7. Determination of ammonia by spectrophotometer
8. Determination of fluoride by spectrophotometer

SENVC-452: Applied Microbiology

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-452	Applied Microbiology	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA						
		Test I	Test II	Avg of (T1+T2) /2	ESA	CA	ESA	
SENVC-452	Applied Microbiology	20	20	20	80	--	--	100

Course Objectives:

Students are expected to have the advanced learning of Environmental microbiology. Course also discusses applications of microbial environment, eutrophication and its management, microorganism in extreme environments, microbial treatment, bioremediation and biodegradation of xenobiotics.

Course Outcomes:

After learning the course, the students should be able to:

1) Use the working knowledge of microbiology to appreciate the role of microbes in environmental pollution problem surveys.
2) Perform basic experiments related to microbiological examination of water/soil/ food.
3) Relate the role of microorganisms in the spread of human diseases and control.
4) Select the type of physical and chemical agents for microbial control for further studies.
5) Justify the role of microbes in bioremediation and industrial use for healthy ecosystem. Course Content.

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit I: Introduction to Microbiology**	**15**
	1.1	History, Diversity and Scope of Microbiology: Importance of microbiology, Morphological Features and Significance.	
	1.2	Viruses, Bacteria Algae, Fungi and Protozoa branches of microbiology: Microbes and food, Dairy Microbiology, Industrial Microbiology.	
	1.3	Soil microbes isolation and significance, Cell elements its composition.	
	1.4	Prokaryotic and Eukaryotic cell Phototrophy, Chemolithotrophy, Anaerobic respiration.	
2.0		**Unit-II: Growth of Bacteria**	**15**
	2.1	Growth and reproduction of bacteria: Concept of Growth and reproduction, mechanism of binary fission, Growth, growth curve of bacterial population and its practical applications, generation time.	
	2.2	Quantitative measurement of bacterial growth, Microbial metabolism and functional diversity of bacteria Prokaryotic diversity.	
	2.3	Microbial ecosystems, Population and community environment, microenvironment.	
	2.4	Microbial growth on surfaces environment, effects on microbial growth, environmental and microbial ecology.	
3.0		**Unit-III: Microscopy**	**15**
	3.1	Microscopy and staining: Microscope, Types, Magnification, Resolution, and use of oil immersion objective, Compound microscope: Principle, Working and significance, Concept and types of stains, Smear Preparation, Simple and Differential staining Grams and acid fast staining.	
	3.2	Classification of bacteria based on: Nutrition, Physical factors: pH, Temperature, Water activity, Aeration, Chemical factors: Media, types of media, media ingredients.	
	3.3	Methods in Microbial culture: Pure culture technique, Streak plate, Pour plate, spread plate. Sterilization methods: Sterilization by Physical agents, Dry heat and moist heat, Radiation etc.	

	3.4	Control of microbes, Pasteurization, Ultraviolet light, Bacteriological examination of potable water MPN (Presumptive, Confirmative and Completed tests), Soil micro-flora, Rhizosphere. Role of microbes in carbon, nitrogen, sulphur cycle.	
4.0		**Unit-IV: Applications of Microbiology**	**15**
	4.1	Application of microbes in environmental conservation, Investigations in environmental microbiology: sampling, detection, isolation.	
	4.2	Bioremediation and wastewater microbiology, Acid mine drainage, Enhanced metal recovery.	
	4.3	Drinking water microbiology, treatment, Water borne microbial diseases.	
	4.4	Epidemiology, endemic, pandemic and biosensors, Public health and microbes, microbial awareness and sanitation education.	
		Total	**60**

SENVP-452 Practicals based on SENVC-452

1. To study the air fungi by PDA preparation
2. To study the bacteria by NA preparation method
3. Determination of Biochemical oxygen demand and Dissolved Carbon dioxide.
4. Determine water quality by MPN method
5. Determination of SPC from various samples
6. Determination of Mobility by Hanging drop technique
7. Study of various colony characteristics from specimens
8. Determination of gram stanning of bacterial suspension
9. Determination of simple stanning of bacterial suspension
10. To study the various laboratorial Equipment's / Instruments

Reference Books

1) Environmental Microbiology: Ralph Mitchell
2) Engineering- Treatment and Reuse: Metcalf and Eddy, Inc., Revised by Tchobanoglous, Burton and Stensel.
3) Introduction to Microbiology: A.S. Rao
4) Environmental Microbiology: Manish L. Shrivastva
5) Handbook of Bioremediation Edited: Norris et al, Robert S. Kerr; Environmental Research Laboratory.
6) Bioremediation Principles: Ewies, Ergas, Chang and Schroeder
7) General microbiology Volume I & II: C. B. Powar & H. F. Daginawala (Himalaya publishing House, Mumbai), 2002
8) Fundamental principles of Bacteriology: A. J. Salle, (Tata McGraw-Hill Publishing Company, New Delhi), 1974
9) Microbiology: P. D. Sharma (Rastogi publication Meerut)
10) Microbiology: Pelczer, Reid & Chan (Tata McGraw-Hill Publishing Company Limited, New Delhi)
11) Handbook of Microbiology: Yu. S. Krivashein (Mir Publishers Moscow)
12) Microbiology for Environmental Engineering: M. C. Kinnery (Tata McGraw-Hill Publishing Company New Delhi)
13) Introduction to Virology: S. B. Biswas
14) General microbiology: Stainier.
15) Applied Microbiology: Kale & Kishore Bhusari (Himalaya Publishing House, Mumbai) 16. Medical Microbiology: Day & Day and Anantnarayan.

SENVC-453 Current Environmental Issues

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVC-453	Current Environmental Issues	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA						
		Test I	Test II	Avg of (T1+T2) /2	ESA	CA	ESA	
SENVC-453	Current Environmental Issues	20	20	20	80	--	--	100

Salient features of this Course:

This interdisciplinary course aims to increase the basic understanding of current environmental problems and their probable solutions. Our environment is changing constantly due to the natural and anthropogenic activities. The students should be aware about these changes, their consequences and solutions to cope up with the situation. These events required urgent attention as they are making us more vulnerable to disasters. Environmental issues are a warning of the future disaster and if they are not controlled, soon earth may become lifeless.

Pre-requisites:

This course may be taken up by students from any discipline to understand the fundamental concepts related to the environmental issues and the science behind them.

Course Objectives:

1) To make students aware with present issues obstructing the sustainable environmental development.
2) To enhance the knowledge about environmental concerns.
3) To develop new methodologies to tackle environmental problems.
4) To encourage students to develop and promote awareness among the society regarding current environmental issues and related information with development of common solutions to the environmental issues.
5) To undertake the role of individual/volunteer in managing these issues and to develop an awareness about environmental issues.

Course Outcomes:

At the completion of the course the students will be able to

1) It will help students to understand burning current environmental problems like epidemic issues, problems associated with various pollutions like Greenhouse effect, global warming, ozone depletion, solid waste and its management etc.
2) Students will learn about the basic environmental issues caused by anthropogenic and natural activities and their impact as well as they will understand preventive and corrective measures to deal with.
3) It may recognize potential environmental impacts of associated problems.
4) Students can think critically and contribute to research in solving contemporary environmental problems with professional and ethical accountability.

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Global Issues**	**15**
	1.1	**Population scenario of India**: effect of population, Deforestation, civilization, industrialization, **Climate Change**: Introduction, history of climate change, Reasons of climate change, effects of climate change, remedial measures of climate change;	
	1.2	**Global Warming**: Concept of Green House Effect, Green House Gases and its Sources, global effects of climate change, remedial measures.	
	1.3	**Ozone Layer Depletion**: Concept, effects of Ozone layer depletion.	
	1.4	**Biodiversity**: Introduction, importance of biodiversity, loss of biodiversity, Habitat loss, Endangered species, Endemic species in India, Conservation Methods of biodiversity: In-situ conservation, Ex-situ Conservation.	
2.0		**Unit-II: Environmental Pollutions**	**15**
	2.1	**Air Pollution:** Definition, sources of air pollution and effects of air pollution, Acid Rain, Photochemical smog, London Smog-1952, Los Angeles-1973, Major Environmental Episodes over the world: Chernobyl Accident, Three mile Iceland, China syndrome, Bhopal Gas Tragedy-A Case Study.	
	2.2	**Water Pollution:** Definition, Global distribution of fresh water, Sources of fresh water, Sources of water pollution, Effects of water pollution, preventive measures of water pollution, Ground Water Pollution, Marine Pollution, Acidification of Ocean	
	2.3	**Soil Pollution:** Definition, Sources of soil pollution, Effects of soil pollution, Preventive measures of soil pollution. Modern agricultural practices.	
	2.4	**Noise Pollution:** definition, sources and effects of plastic pollution. **Plastic Pollution:** definition, sources and effects of plastic pollution.	

		Nuclear Pollution: Sources, effects and control measures of nuclear pollution.	
3.0		**Unit-III: Development-Environment conflict**	**15**
	3.1	Developmental issues and related impacts such as ecological degradation, environmental pollution.	
	3.2	Development-induced displacement, resettlement and rehabilitation: problems, concerns, and compensative mechanism.	
	3.3	Project affected people (PAP's) Social and Cultural construction of Environment.	
	3.4	Historical developments in cultural, social and economic issues related to land, forest and water management in a global context, Interface between environment and society.	
4.0		**Unit-IV: Urbanization and environment**	**15**
	4.1	Production and consumption-oriented approaches to environmental issues in Indian as well as global context	
	4.2	Impact of industry and technology on environment.	
	4.3	Urban sprawl, traffic congestion and social-economic problems	
	4.4	conflict between economic and environmental interests.	
		Total	**60**

Reference Books

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) Guha, R. 1989. *Ecological change and peasant resistance in the Himalaya*. Unquiet Woods,Oxford University Press, Delhi.
4) National Research Council (NRC). 1996. *Linking Science and Technology to Society's Environmental Goals*. National Academy Press.
5) Pandit, M.K. 2013. Chipko: Failure of a Successful Conservation Movement. In: Sodhi, N.S.,Gibson, L. & Raven, P.H. *Conservation Biology: Voices from the Tropics.* pp. 126-127. Wiley-Blackwell, Oxford, UK.
6) Environmental Chemistry: B. K. Sharma Goel Publishing House, Meerut.
7) Environmental Science: Enger Smith, Smith, W. M. C. Brown, Company Publishing.
8) Fundamentals of Environmental Science: *G. S. Dahliwal, G. S. Sangha, P. K. ralhan, Kalyani Publishers, New Delhi*
9) Textbook of Environmental Studies for Undergraduate Courses: ErachBharucha (Universities Press), 2013.
10) Introduction to Environmental Science: Y. Anjaneyulu (B.S. Publication), 2008.
6) Environmental Science: UGC NET/SET (Danika Publishing Company), 2018.

SENVP-453 Practicals based on SENVC-453

1. To explore and demonstrate the effectiveness of water management techniques in reducing water consumption in irrigation practices.
2. Calculate the rainwater precipitation by using rain gauge
3. Determine the total hardness of water samples
4. Determine the water quality index
5. Study the water sampling techniques
6. To observe the color content of the different water samples
7. Visit the nearest watershed management project
8. Determination of Particulate matter from the nearby area

SENVE-451: Disaster Management & Mitigation

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVE-451	Disaster Management & Mitigation	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2) /2		CA	ESA	
SENVE-451	Disaster Management & Mitigation	15	15	15	60	--	--	75

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Disaster**	**15**
	1.1	Definition, Classification of hazards/disasters and its types; Natural and Man Induced Disasters: Their causes, distribution and adverse effects	
	1.2	(Natural: Volcanism, Earthquake, Floods, Droughts, Landslide & Mass wasting, Tsunamis, Storm.	
	1.3	Cyclones, Cloud Bursts, Cold and Heat Waves, Forest Fire Manmade: Industrial accidents, Stampedes.	
	1.4	Pollution, Gas leaks, Radioactive leak, Water scarcity, Salinization of soils, Epidemics, Deforestation and Desertification, Earthquakes, Extreme heat, Urban flooding & flash floods) (Should be complemented with historical and recent case studies)	
2.0		**Unit-II: Workflow of Disaster Management & Mitigation**	**15**
	2.1	Disaster, Preparedness, Response, Recovery & Mitigation	
	2.2	Natural Disaster Management & Mitigation- Definition and Purposes, Disaster Monitoring.	
	2.3	Warning Systems; Remote Sensing and GIS for Disaster Management	
	2.4	Role of community in Disaster Management- Disaster Management Planning in India at Central level. State level, District & Local level.	
3.0		**Unit-III: Vulnerability & Risk Assessment**	**15**
	3.1	Identification and control of hazards, Risk Analysis –	
	3.2	Definition, Various Techniques of Risk Analysis for Industries, HAZOP, HAZAN, FMEA.	
	3.3	Fault Tree Analysis, Event Tree, Dose Response Relationship.	

	3.4	Introduction to Disaster Response – First Aid; Cardiac Pulmonary Resuscitation (CPR), Personal Protective Equipment.	
		Total	**45**

Reference Books

1) Disaster Management - B. Narayan, APH Publishing Corporation
2) Industrial Disaster Management - Chakrabarty U.K., Asian company, new Delhi
3) Risk Assessment- An Environmental Perspective - Peter K.Lagoy, Jaico Publishing House, Mumbai
4) Industrial Occupational Safety, Health and Hygiene - A.H. Hommadi, Indian Bibliographies Bureau, New Delhi
5) Pesticides, Man and Biosphere - O.P. Shukla, APH Publishing Corporation, New Delhi
6) Websites of Government of India.

SENVE-452 Practicals based on SENVE-451

1. Study the safety equipment's for disaster management
2. To study the vulnerability of the given area
3. Visit the water resource for the study Dam/Reservoir/River/Ponds/Lakes
4. To study and handle the fire extinguisher
5. To study and uses of PPE for safety
6. Instructions about industrial safety and guidelines
7. To visit the industrial area / MIDC
8. To study the hazardous and non-hazardous waste from industries

SENVE-453 Habitat and Wildlife: Conservation & Management

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SENVE-453	Habitat and Wildlife: Conservation & Management	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2) /2		CA	ESA	
SENVE-453	Habitat and Wildlife: Conservation & Management	15	15	15	60	--	--	75

Course Content

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Unit-I: Introduction of Wildlife**	**15**
	1.1	Wildlife habitat and bio-geographical regions of the world Habitat, component of habitat Wild flora and fauna, macro and micro flora and fauna, wild habitats and wilderness, zoogeography of the world.	
	1.2	zoogeographical regions; Wildlife and biogeography of India and the Indian Subcontinent Wild flora and fauna of India. Zoogeography of India.	
	1.3	Zoogeography of India. The convergence of zoogeographical regions in the Indian Subcontinent.	
	1.4	Our neighbouring zoogeographical regions; the various sciences in wildlife studies Mammalogy, Ornithology, Ichthyology, Herpetology, Entomology, Population ecology, Animal ethology, Phenology.	
2.0		**Unit-II: Wildlife Management & Biodiversity**	**15**
	2.1	Wildlife management Introduction to wildlife habitat management. Laws, Acts and rules for wildlife conservation and management. Protected Areas of India. National Parks and Wildlife Sanctuaries. Community Conservation Areas. Biodiversity\ Registers. The Indian Forest Service. State Forest Services. Coastal Regulation Zones.	
	2.2	Biodiversity: global and regional changes in biodiversity, reasons for global patterns of biodiversity, different concepts of biodiversity, the value of biodiversity, biodiversity strategies (preserves with unique habitats with maximum number of threatened species, so-called hotspots	
	2.3	versus preserving an acceptable diversity in the cultural landscape), consequences of introduction of new species, genetically modified organisms, and restoration ecology.	
	2.4	In addition to strict scientific aspects of conservation biology, ethical perspectives will also be discussed and	

		highlighted: what should be preserved, why and for whom?	
3.0		**Unit-III: Vulnerability & Risk Assessment**	**15**
	3.1	Major wildlife habitats and conservation areas in India: The major conservation zones for wildlife in India – the Himalayas (Corbett), the North-East (Namdapha), the Western Ghats (Nawegaon-Nagzira, Mudumalai, Bandipur, Mundanthurai, Point Calimere, Periyar) and the Eastern Ghats, the Satpuras(Bandavgarh, Tadoba, Kanha) and the Vindhyans (Chambal), the Rivers of India, the deserts (Keoladeo Ghana) and semi-arid regions and the West & East Coast, the Islands in the Indian Ocean,	
	3.2	Conservation breeding and zoo management: Captive breeding, In-situ and Ex-situ conservation, major zoological parks of India, the Central Zoo Authority. Role of modern genetics and biosciences in captive breeding of endangered species.	
	3.3	Scientific analytical methods: vulnerability analysis (basic analytical methods on the viability of populations, "Population Viability Analyses"), models in harvest theory.	
	3.4	The scientific basis for creation of wildlife preserves, behavioural indicators in conservation biology, statistical analysis of population trends, and evaluation of 6 conservation ecology studies.	
		Total	**45**

Reference Books

1) P.J. Darlington, 1957. The zoogeography: The geographical distribution of animals. Wiley Publ. New York. 675 pages. Krieger Pub. Co. (June 1980).
2) Wilma George, 1962. Animal geography. Heinemann Edu. Books Ltd. 142 pages.
3) John C. Briggs, 1974. Marine Zoogeography (Population Biology). Frank Evers Beddard, 2008.
4) Miklos D. F Udvardy, 1969. Dynamic zoogeography: With special reference to land animals. 445 pages. Van Nostrand Reinhold (1969).
5) L F De Beaufort, 1951. Zoogeography of the Land & Inland Waters
6) S.K. Tiwari, 1985. ZooGeography of India and Southeast Asia. International Book Dist. Dehra Dun.
7) S.K. Tiwari, Zoogeography of Indian Amphibians. Today & Tomorrow Printers and Publishers

8) S K Tiwari, Faunal Regions of the World. Vedams eBooks (P) Ltd (India).
9) Shivkumar Tiwari, 1985. Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers. Pages: 395.
10) Joachim Illies, 1974. Introduction to Zoogeography. Macmillan (January 1974)
11) Paul Muller, 1974. Aspects of Zoogeography. Junk Pub. (January 1974).
12) A.R. Wallace, 1962. The geographical distribution of animals. Hafner Publ. Co. 503 pages.
13) Carl L. Hubbs (Editor), 1974. Zoogeography (Hardcover). 509 pages. Ayer Co Pub;

SENVE-454 Practicals based on SENVE- 453

1. To visit the national park / wildlife sanctuary
2. To study the biodiversity of plants from nearby area
3. To study the biodiversity of animals from nearby area
4. To determine the pH of different soil samples
5. Identification of phytoplankton any 5 to 10 specimens
6. Identification of Zooplankton any 5 to 10 specimens
7. To study the flora density by quadrat method
8. Collect the list of endangered and extinct species of flora and fauna