॥ 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

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

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/एनइपी/विवत्रंविपदवी/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

(Credit Framework and Structure of Four Year UG Program with Multiple Entry and Exit Option as per NEP-2020)

UNDERGRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

Major in **DSC** and Minor in **DSM** (Subject)

(B.Sc. Environmental Science – II Year)

Under the Faculty of Science & Technology

(Revised as per the Govt. Of Maharashtra circular dt. 13th March 2024)

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power***", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve ***the 3Es, the equity, the efficiency*** and ***the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put

in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the **Government of Maharashtra regarding NEP-2020**. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship program*** for science background students is praise worthy and certainly help the students to imbibe firsthand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil
Dean
Faculty of Science and Technology

From Desk of Chairman, Board of Studies of the Subject Environmental Science and Earth Science

PREAMBLE

Introduction:

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 GER 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 UG and PG level from the academic year 2023-2024.Keeping in mind, BOS in Environmental and Earth Science has prepared the curriculum to ensure up-to-date level of understanding of Environmental Science. Studying Environmental Science 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 UG/PG level, curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, and the UGC model curriculum are referred to serve as a base in updating the same. The comments or suggestions from all teachers, students and other stakeholders are welcome for upbringing this curriculum.

Salient Features:

The syllabus of B.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 Environmental Science. This would help students to lay a strong foundation in the field of Environmental Science.

Overall, after completion of this course, students will also acquire fundamental knowledge and applications in Environmental Science 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 themselves to the diversity amongst life forms and their interactions.

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 and enable the students to face NET, SET, 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 employability 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 and enable the students to face NET, SET, 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 employability and 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.

Prerequisite:

The students seeking admission to B.Sc. Environmental Science should have passed plus two examinations. The optional courses are offered to the students registered for graduate and post-graduate programs. Such students should have the basic knowledge of Environmental Science and willing to gain additional knowledge in the field of Environmental Science. Admissions to this program are given as per the University rules.

Dr. Vasant Madhav Wagh
Associate Professor,
Chairman, BOS Environmental & Earth Science,
Swami Ramanand Teerth Marathwada University, Nanded.
Mobile: 9881737252
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Details of the Board of Studies Members in the subject Environmental Science and Earth Science under the Faculty of Science & Technology, S.R.T.M. University, Nanded.

Dr. Vasant Madhav Wagh **Chairman** School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Nanded 431606.	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 2023 UG and PG Students	
Shaikh Humedsalman Shaikh Aminullah C/o Yeshwant Mahavidyalaya, Nanded	Maniyar Fatema Ismail C/o Maharashtra Udaygiri Mahavidyalaya, Udgir, Tq. Udgir Dist. Latur

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

General Guidelines for Selection of Courses

i. The **Major subject** is the discipline or course of main focus, bachelors' degree shall be awarded in that Discipline / subject.

ii. **Minor Subject(s)** is/are the subjects from the same discipline / faculty and shall act as supporting subjects to the Major.

iii. At the entry level of the 3/4-year UG program students shall be required to choose any THREE of the available subjects in a college/institute as **Major (Optional 1), Minor 1 (Optional 2) and Minor 2 (Optional 3) subjects, respectively**

iv. No. of credits assigned to the **Major (Optional 1), Minor 1 (Optional 2) and Minor 2 (Optional 3) shall be same in Semesters I and II.**

v. **In the second year of the degree program students shall select one of the three subjects (Optional 1, 2 and 3) as a Major Subject and one as Minor Subject, while third optional shall be discontinued.**

vi. Students shall have an option to switch over from **Major to Minor or vice-versa after first year**.

vii. Once they finalize their **Major subject** in the beginning of the second year of the programme, they shall pursue their further education in that particular subject as the **Major** subject. Therefore, from second year onwards curriculum of the **Major** and **Minor** subjects shall be different.

viii. Students are required to select **Generic /Open Elective** (**vertical 3 in the credit framework**) compulsorily from the **faculties different than that of their Major / Minor subjects** (select from **Basket 3**).

ix. Content and other details of the GE are available in the document prepared by the respective BOS from which the candidate has chosen his/her GE.

x. Students shall be required to complete the Skill based courses of 06 credits in the first two years.

xi. Vocational Courses (VSEC or VSC) shall be related to the **Major** course

xii. Ability Enhancement Courses (AEC):

a) English Communication Course (Language) of 2 credits shall be offered in Semester I and III

b) Modern Indian Languages shall be of 2 credits and shall be offered in Semester II and IV

xiii. Courses marked as VEC, CI, IKS and CCC in Column Nos. 7and 8 shall be common for all the students irrespective of their faculties of studies.

xiv. Curriculum of VEC, CI, IKS and CCC shall be provided by the University separately.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606

Summary of the Credits Assigned to various courses to be proposed by the Board of Studies under the Faculty of Science and Technology

A. No. Of Credits assigned to various courses:

Sr No.	Heads	Credits assigned in each Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Major Subject	4	4	8	8	16	16	18/14	18/14	92/84
2	Minor 1 Subject	4	4	2	2	--	--	--	--	12
3	Minor 2 Subject	4	4	--	--	--	--	--	--	08
3	Generic Electives / Research Methodology	2	2	4	2	--	--	4	--	10 + 4 (14)
4	Vocational and Skill Enhancement Course / Indian Knowledge System	2	2	2	2	4	2	--	--	8+6 (14)
5	Ability Enhancement Course L1 (English)	2	--	2	--	--	--	--	--	4
6	Ability Enhancement Course L2 (SL)	--	2	--	2	--	--	--	--	4
7	Value Added Course /IKS (Constitution of India / EVS)	2	2	--	2	--	--	--	--	6
8	Community Engagement Services NCC/NSS/Sports/Culture	2	2	2	2	--	--	--	--	8
9	Project/ Field Work/ OJT /Internship	--	--	2	2	2	4	--/4	4/8	14/22
10	Total Credits	22	22	22	22	22	22	22	22	176

1. **Major Courses** *(92 / 84 credits, Basket-1)*:Each BOS shall suggest**Major Courses** of 04 credits **(02 credit Theory and 02 credit practical papers)** for semesters I and II
   As the University has adopted Three Optional credit framework, therefore, every student have a freedom to chose three courses of his choice from among the options made available by a particular college / institute. As number of credits assigned to all the three optional are same, therefore, he / she have a freedom to select any one of them as Major and one as Minor course from second year onward.

2. **Minor Courses *(20 + 04 credits, Basket-2):*** **Total numbers of credits assigned to the Minor Courses are 20** and a course on Research Methodology of 4 credits in VIIth semester.

   [Note: *i.* Each Board of studies is required to develop curriculum of **two theory papers and a practical course each of 02 credits**. This would be **common for major and minor courses** during semesters I and II. **No need of preparing Minor courses separately for First Year**.
   ii. Students have option to select any of the three optional as **Major** and one **Minor** at the beginning of the **Third Semester (Second Year)** of their degree programme.]

3. **Generic Electives *(10 credits; for students from faculties other than Science and Technology, Basket-3)*:** One paper each of **02/04 credits to be offered in semester I to VI** as Generic Electives. As these papers shall be opted by the students from other faculties; therefore, difficulty level of these courses shall at beginners' level (4.0). Each BOS shall **suggest a minimum of one and a maximum of four Generic Elective papers** to be offered during semesters I to VI. Students have freedom to choose one **Generic Elective** paper from **Basket-3** (common for all faculties) in each semester, provided these GE courses are from other faculty.

4. **Ability Enhancement Course (AEC) *(08 credits; common for all faculty students, Basket-4)*:** One Language course each of 02 credits in the first four semesters.
   L1 – First Language English *(Compulsory for all disciplines)* *(02 credits each in semesters I and III)*
   L2 – Second Language (Students have option to choose second language from the **Language Basket-IV**) *(02 credits each in semesters II and IV)*

5. **Vocational and Skill Enhancement Courses (VC/SC) *(08 +06 credits, shall be related to the Major Course)*:**
   Each BOS shall suggest four Vocational and three Skill Enhancement Courses each of 02 credits to be offered in semesters I to VI. These courses shall be related to the **Major subject**.

6. **Indian Knowledge System (IKS) (Generic) *(02 credits, common for all faculties, Basket-5)*:** Students have a freedom to choose a course on **Indian Knowledge System** of 02 credits from ***Basket-5*** and shall be common for the students from all faculties of study.

7. **Value Education Courses (VEC) *(04 credits, common and compulsory for all faculty students)*:** Students have to complete two Value Added courses each of 02 credits during semester V and VI and are compulsory for students of all faculties.
   a*. Constitution of India *(02 credits) – in Semester V
   b*. Environmental Studies *(02 credits) – in Semester VI

8. **Community Engagement Services (CES / CCC)*(08 credits, common for all faculty students)*:** Students need to complete four **Community Engagement Services** courses like **NCC, NSS, Sports, Cultural Studies** each of 02 credits in first four semesters I, II, III and IV and are common across the faculty.
   Grades of NCC/NSS/Sports/Cultural courses shall be awarded to the students on the basis of their participation in University, Regional, National, International, Inter-University and Intra-University level activities. Guidelines for the award of grades for NCC/NSS/Sports/Cultural studies shall be prepared by a Committee constituted by the University.

9. **Field Work / Projects/ OJT/ Internship/Apprenticeship related to DSC major subjects *(14 credits for Honours and 22 credits for Honours with Research credits)*:** The students shall have to complete Field Work, Project, Case Study, Internship or Apprenticeship, etc. as per the credit framework.

10. **Bachelor of Science in DSC Honors and Minor in DSM.**

For the award of **Bachelor of Science in DSC Honors and Minor in DSM** students have to complete **92 credits** from Major, **20** credits of Minor and the required number of credits of Field Work / Projects/ Internship/Apprenticeship/Case study **related to Major subject**.

11. **Bachelor of Science in DSC Honors with Research and Minor in DSM.**

For the award of **Bachelor of Science in DSC Honors with Research and Minor in DSM** students have to complete **84 credits** theory courses of Major subject, **20 credits** of Minor and required number of credits of Field Work / Projects/ Internship/Apprenticeship/Case study **related to Major subject**.

12. **These guidelines are as per the present instructions from Government of Maharashtra and are subject to change time-to-time as per the guidelines from Govt. of Maharashtra.**

MULTIPLE EXIT Options for Students:

1. **Exit Option after First year**

Students may take exit after completion of first year with **Certificate in Major (DSC) and Minor (DSM) subject** on completion of minimum 44 credits and additional 4 credits of NSQF skill / vocational in major/minor subject or internship during summer vacation.

2. **Exit Option after Two years**

Students may take exit after completion of second year of the programme with **Diploma in Major (DSC) and Minor (DSM)** subject on completion of minimum 88 credits and additional 04 credits on NSQF skill / vocational or Internship on major/minor courses during summer vacation.

3. **Exit Option after Three years**

Students may take exit with a Degree as **Bachelors of Science in Major (DSC) and Minor (DSM)** after earning minimum of 132 credits.

4. **Exit Option after Four Years** after completing 176 credits

(a) Bachelor of Science in DSC Honours and Minor in DSM.

(b) Bachelor of Science in DSC with Research and Minor in DSM.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology (Three Optional in the First Year)

Credit Framework for Four Year Multidisciplinary Degree Program
with Multiple Entry and Exit
Subject: DSC (Major) /DSM (Minor 1 and Minor 2)
(For illustration ENV SCI, CHE and BOTcombinations are considered, which may change for different combinations)

Year & Level	Semester	Optional 1 (Major) *(From the same Faculty)*	Optional 2 (Minor 1) *(From the same Faculty)*	Optional 3 (Minor 2) *(From the same Faculty)*	Generic Elective (GE) (select from Basket 3 of *Faculties other than Science and Technology*)	Vocational & Skill Enhancement Course	Ability Enhancement Course (AEC) (Basket 4) Value Education Courses (VEC) / Indian Knowledge System (IKS) (Basket 5) *(Common across all faculties)*	Field Work / Project/Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CCC) (Basket 6 for CCC) *(Common across all faculties)*	Credits
1	2	3	4	5	6	7	8	9	10
2 (5.0)	III	**SENVCT1201 Environmental Chemistry (2cr) SENVCT1202 Water & Water Resources (2cr) SENVCP1201 Based on SENVCT1201(2cr) SENVCP1202 Based on SENVCT1202 (2cr) 8 Credits**	**SENVMT1201** Environmental Biology (T) **SENVMP1201 (P) Practicals based on SENVMT1201** (2T+2P) **4 Credits**		**SENVGE1201 Water conservation practices (2cr) 2 Credits**	**SENVSC1201 Rain Water Harvesting 2 Credits**	**ACEXXX1201 (MAR/HIN/URD/KAN /PAL)**(2Cr) **4 Credits**	**SPHYFP1201 (2Cr) CCCXXX1201(2Cr) 2 Credits**	**22**
	IV	**SENVCT1251 Atmosphere & Global Climate Change (2cr) SENVCT1252 Biodiversity & Conservation (2cr) SENVCP1251 (2cr) based on SENVCT1251**	**SENVMT1251 Introduction to Pollution (T) SENVMP1251 (P)** (2T+2P) **4 Credits**		**SENVGE1251 Climate change (2cr) 2 Credits**	**SENVVC1251 Sustainable Agriculture practices 2 Credits**	**ACEXXX1251 (MAR/HIN/URD/KAN /PAL**(2Cr) **VECEVS1251**(2Cr) **3 Credits**	**SPHYFP1351(2Cr) CCCXXX1151(2Cr) 4 Credits**	**22**

		SENVCP1252 (2cr) **SENVCT1252** **8 Credits**								
	Cum. Cr.	**16**	**08**	**00**	**04**	**04**	**10**	**02**	**44**	
***Exit option*: UG Diploma in Major DSCand Minor DSMon completion of 88 credits and** additional **4 credits NSQF / internship in DSC**										

Basket 1: Major Subject Environmental Science (8 Cr)

* Students will have to choose one subject from Basket 1 as a Major subject, from same faculty or other but other than DSC (in col. 3)

Semester	BOS proposing Major	Details of major Subject	
		CODE	**Title of the Corse**
Semester III	**BOS in Environmental and Earth Sciences**	**SENVCT1201** **SENVCP1201**	**Environmental Chemistry** **Practicals based on SENVCT1201**
		SENVCT1202 **SENVCP1202**	**Water & Water Resources** **Practicals based on SENVCT1202**
Semester IV	**BOS in Environmental and Earth Sciences**	**SENVCT1251** **SENVCP1251**	**Atmosphere & Global Climate Change** **Practicals based on SENVCT1251**
		SENVCT1252 **SENVCT1252**	**Biodiversity & Conservation** **Practicals based on SENVCT1252**

Basket 2: Minor Subject Environmental Science (4 Cr)

* Students will have to choose one subject from Basket 2 as a Minor subject, from same faculty or other but other than DSM (in col. 3)

Semester	BOS proposing Major	Details of minor Subject	
		CODE	**Title of the Corse**
Semester III	**BOS in Environmental and Earth Sciences**	**SENVMT1201** **SENVMP1201**	**Environmental Biology** **Practicals based on SENVMT1201**
Semester IV	**BOS in Environmental and Earth Sciences**	**SENVMT1251** **SENVMP1251**	**Introduction to pollution** **Practicals based on SENVMT1251**

Basket 3: Generic Elective course (GE) (2 Cr)

* Note: Each BOS shall suggest Generic Elective Courses for semesters III and IV
Students will choose one GE course each from below (other than subjects DSC and DSM in col. 3 and 4).
(For e.g. As given in table below)

Semester	BOS proposing Major	Details of minor Subject	
		CODE	**Title of the Corse**
Semester III	**BOS in Environmental and Earth Sciences**	**SENVGE1201**	**Water conservation practices**
Semester IV	**BOS in Environmental and Earth Sciences**	**SENVGE1251**	**Climate change**

Basket 4: Skill Enhancement course (SEC) (2 Cr)

Note: Each BOS shall suggest Skill Enhancement Courses for semesters III and IV
* Students will choose one GE course each from below (other than subjects DSC and DSM).
(For e.g. As given in table below)

Semester	BOS proposing Major	Details of minor Subject	
		CODE	**Title of the Corse**
Semester III	**BOS in Environmental and Earth Sciences**	**SENVSC1201**	**Rainwater harvesting**
Semester IV	**BOS in Environmental and Earth Sciences**	**SENVSC1251**	**Sustainable agriculture practices**

Abbreviations:

1. **DSC:** Department/Discipline Specific Core (Major)
2. **DSE:** Department/Discipline Specific Elective (Major)
3. **DSM:** Discipline Specific Minor
4. **GE/OE:** Generic/Open Elective
5. **VSEC:** Vocational Skill and Skill Enhancement Course
6. **VSC:** Vocational Skill Courses
7. **SEC:** Skill Enhancement Courses
8. **AEC:** Ability Enhancement courses
9. **MIL:** Modern Indian languages
10. **IKS:** Indian Knowledge System
11. **VEC:** Value Education Courses
12. **OJT:** On Job Training: (Internship/Apprenticeship)
13. **FP:** Field Projects
14. **CEP:** Community Engagement and Service
15. **CC:** Co-Curricular Courses
16. **RM:** Research Methodology
17. **RP:** Research Project/Dissertation

Swami Ramanand Teerth Marathwada University, Nanded

Assigning TEN DIGIT Codes to the CoursesALPHANUMERIC Coding AAAAAA XXXX

1) First (A) Letter indicate Faculty:H– Humanities; **S** - Science; **C**– Commerce, & Management,**I** - Interdisciplinary Studies and **D** –Distance / External mode .

2) Next Three Letters(XXX) indicates Subject (e.g. **ECO** – Economics, **PHY** – Physics, **COM** – Commerce, **CSC** – Computer Sci.) etc.

3) Fourth and Fifth Letters indicate nature of the course : (e.g. **CT** – Core Theory, **CP** – Core Practical, **MT** – Minor Theory, **ET**– BOTctive Theory, **EP** – BOTctive Practical, **FP**– Field Project, **FW** – Field Work, **OJ** – On Job training, **GE** - Generic /open BOTctive, **IN** – Internship, **CS** – Case Study, **VC** -Vocational Skill Courses, **SC** -Skill Enhancement Courses, **AEC** -Ability Enhancement courses, **ML** -Modern Indian languages, **CCC** - Co-Curricular Courses/ Community Engagement and Service, **RM** -Research Methodology,**IKC** - Indian Knowledge System,**VEC** - Value Education Courses, etc.)

4) Sixth Character or First Number: indicate the Centre (**1**- for Affiliated colleges, **2** -Main Campus,**3**- Model Degree College, **4**- Sub-Centre Latur, **5**-Sub-Centre Parbhani, **6** –Sub-Centre Kinwat)

5) Seventh Character or second number indicate -Year of Study.e.g.**1** - First year,**2**- second year.etc.

6) Last Two Numbers indicate Course Number

e.g. **SPHYCT1101**– Faculty of **Science & Technology (S)PHYSICS** (PHY) subject **Core Theory** (**CT**) Course offered in the First Semester inaffiliated colleges

Sr. No	UG/PG	Semester	Affiliated Colleges	Main Campus	Model Degree College	Sub-center Latur	Sub-center Parbhani	Sub-Centre Kinwat
1	First Year	Semester I	1101 to 1150	2101 to 2150	3101 to 3150	4101 to 4150	5101 to 5150	6101 to 6150
2		Semester II	1151 to 1199	2151 to 2199	3151 to 3199	4151 to 4199	5151 to 5199	6151 to 6199
3	Second Year	Semester III	1201 to 1250	2201 to 2250	3201 to 3250	4201 to 4250	5201 to 5250	6201 to 6250
4		Semester IV	1251 to 1299	251 to 2299	3251 to 3299	4251 to 4299	5251 to 5299	6251 to 6299
5	Third Year	Semester V	1301 to 1350	2301 to 2350	3301 to 3350	4301 to 4350	5301 to 5350	6301 to 6350
6		Semester VI	1351 to 1399	2351 to 2399	3351 to 3399	4351 to 4399	5351 to 5399	6351 to 6399
7	Fourth Year	Semester VII	1401 to 1450	2401 to 2450	3401 to 3450	4401 to 4450	5401 to 5450	6401 to 6450
8		Semester VIII	1451 to 1499	2451 to 2499	3451 to 3499	4451 to 4499	5451 to 5499	6451 to 6499
9	Fifth Year	Semester IX	1501 to 1550	2501 to 2550	3501 to 3550	4501 to 4550	5501 to 5550	6501 to 6550
10		Semester X	1551 to 1599	2551 to 2599	3551 to 3599	4551 to 4599	5551 to 5599	6551 to 6599

B. Sc. Second Year Semester III *(Level 5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1 (major) From the same faculty	SENVCT1201	Environmental chemistry	02	--	**08**	02	--
	SENVCP1201	Practical Based on SENVCT1201	-	02			04
	SENVCT1202	Water and water resources	02	--			
	SENVCP1202	Practical Based on SENVCT1202	-	02			
Optional 2 (minor 1) From the same faculty	SDSCMT1201	Environmental biology	02	--	**04**	02	--
	SDSCMP1201	Environmental biology (practical)	-	02			04
Optional 3 (minor 2) From the same faculty	SDSCMT1101	Title of paper 1	02	--	**04**	02	--
	SDSCMP1101	Title of paper 2 (practical)	-	02			04
Generic Electives *(from other Faculty)*	SENVGE1201	Water conservation practices (Basket 3 of respective faculty)	02	--	**02**	02	--
Skill Based Course (related to Major)	SENVSC1201	Rain water harvesting	--	02	**02**	--	04
Ability Enhancement Course	ACEXXX1201	(MAR/HIN/URD/KAN/PAL)	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1101	SBOTct from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1101	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

B. Sc. Second Year Semester III *(Level 5)*

Examination Scheme

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

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1 (major) From the same faculty	SENVCT1201	Environmental chemistry	10	10	10	40	--	--	50
	SENVCP1201	Practical Based on SENVCT1201	--	--	--	--	20	30	50
	SENVCT1202	Water and water resources	10	10	10	40	--	--	50
	SENVCP1202	Practical Based on SENVCT1202	--	--	--	--	20	30	50
Optional 2 (minor 1) From the same faculty	SDSCMT1201	Environmental Biology	10	10	10	40	--	--	50
	SDSCMP1201	Environmental Biology (P)	--	--	--	--	20	30	50
Optional 3 (minor 2) From the same faculty	SDSCMT1101	Title of paper 1	10	10	10	40	--	--	50
	SDSCMP1101	Title of paper 2 practical	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SENVGE1201	Water conservation practices (Basket 3 of respective faculty)	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SENVSC1201	Rain water harvesting	--	--	--	--	20	30	50
Ability Enhancement Course	ACEXXX1201	(MAR/HIN/URD/KAN/PAL)	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1101	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1101	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

B. Sc. Second Year Semester IV *(Level 5)*

Teaching Scheme

	Course Code	CourseName	CreditsAssigned			TeachingScheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	**SENV**CT1251	Atmosphere and global climate change	02	--	**04**	02	--
	SENVCP1251	Practical Based on SENVCT 1251	-	02			04
	SENVCT1252	Biodiversity and conservation	02		**04**	02	-
	SENVCP1252	Practical Based on SENVCT 1252		02			04
Optional 2	SDSCMT1251	Introduction to pollution	02	--	**04**	02	--
	SDSCMP1251	Practical Based on SENVMT 1251	-	02			04
Optional 3	SDSCMT1101	Title of paper 1	02	--	**04**	02	--
	SDSCMP1101	Title of paper 2 (practical)	-	02			04
Generic electives *(from other Faculty)*	SENVGE1251	Climate change	02	--	**02**	02	--
Skill Based Course (related to Major)	SENVSC1151	Sustainable agricultural practices	--	02	**02**	--	04
Ability Enhancement Course	AECENG1101	L1 – Compulsory English	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1101	SBOTct from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1101	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

B. Sc. Second Year Semester IV *(Level 5)*

Examination Scheme

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

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	CourseName (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	**SENV**CT1251	Atmosphere and global climate change	10	10	10	40	--	--	50
	SENVCP1251	Practical Based on SENVCT 1251	--	--	--	--	20	30	50
	SENVCT1252	Biodiversity and conservation	10	10	10	40	--	--	50
	SENVCP1252	Practical Based on SENVCT 1252	--	--	--	--	20	30	50
Optional 2	SDSCMT1251	Introduction to pollution	10	10	10	40	--	--	50
	SDSCMP1251	Practical Based on SENVMT 1251	--	--	--	--	20	30	50
Optional 3	SDSCMT1101	Title of paper 1	10	10	10	40	--	--	50
	SDSCMP1101	Title of paper 2 (practical)	--	--	--	--	20	30	50
Generic BOTctive	SENVGE1251	Climate change	10	10	10	40	--	--	50
Skill Based Course	SENVSC1151	Sustainable agricultural practices	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1101	**L1 – Compulsory English**	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1101	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1101	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

B. Sc. Second year

Environmental Science

SEMESTER – III

SENVCT1201: Environmental Chemistry (2 credit)

Course pre-requisite:

- The paper deals with fundamental knowledge of Environment chemistry which include soil and water and circulations of various elements in nature, meteorological phenomena and atmospheric chemistry.

Course Objectives:

- To built-up scientific approach towards Environmental chemistry.
- To acquire the knowledge necessity of elements and its circulations in nature
- To examine the chemical processes and interactions occurring within the environment, including the sources, transport, transformation, and effects of pollutants, with the aim of understanding and mitigating their impact on ecosystems and human health.

Course Outcomes:

- Key outcomes would include the ability to identify environmental pollutants.
- Analyze their chemical properties; assess their environmental fate and toxicity.
- Propose potential mitigation strategies based on scientific evidence.

Curriculum Details:

Module No	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Fundamental of environmental chemistry and Atmospheric chemistry**	**07**
	1.1	Fundamental of environmental chemistry, chemical processes in environment. Evolution of atmosphere, structure and composition of atmosphere	
	1.2	Chemical and photochemical reactions in atmosphere: Particles, ions and radicals present in the atmosphere.	
	1.3	Acid rain formation and its chemistry, oxygen and ozone chemistry, ozone depletion, sulphur dioxide, nitrogen oxide etc.	
	1.4	Photo-chemical reactions involved in photochemical smog formation, Green house effect/ Global warming.	
2.0		**Water chemistry**	**08**
	2.1	Hydrological cycle, aquatic environment, pathway of pollutants, Eutrophication.	

	2.2	**Physical property**: Temperature, specific gravity, viscosity, thermal conductivity, surface tension, solvency, buoyancy, transparency, pressure.	
	2.3	**Chemical property:** Salinity, solubility of gases (O_2, CO_2, N_2), pH, Hydrogen sulphide.	
	2.4	**Biological property:** Phyto-benthos organism, Phytoplankton, Zooplankton, Macro-invertebrates and Microbes	
3.0		**Soil chemistry**	**07**
	3.1	Soil composition; relation between organic carbon and organic matter	
	3.2	Inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil	
	3.3	Nitrogen, phosphorus and potassium in soil; phenolic compounds in soil	
	3.4	Soil nutrients, soil salinity and alkalinity,	
4.0		**Toxicological chemistry**	**08**
	4.1	Toxic chemicals in environment, Impacts of toxic chemicals,	
	4.2	Physiological responses to toxicants: Teratogenesis, mutagenesis and carcinogenesis; Neurotoxins	
	4.3	Toxicity Of Metals, Inorganic Compounds & Organic Compounds	
	4.4	Toxic elements: Hg, Cd, As, Pb toxicity of some inorganic compounds: CN (Cyano group), CO, NO(x), SO_2, O_3.	
		Total	**30**

Text Books:

- **Environmental chemistry:** A. K. DE New AGE International publishers.
- **A textbook of Environmental Studies**: G. R. Chatwal, Harish Sharma, Himalaya Publishing House, New Delhi
- **Fundamentals of Ecology:** Eugene P. Odum, (Natraj Publishers, Dehradun.)
- **Principles of Ecology:** P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
- **Environmental Biology:** P. D. sharma (Rastogi Publications, Meerut)
- **Ecology and Environment:** P. D. sharma (Rastogi Publications, Meerut)
- **Principles of Environmental Biology:** P. K. G. Nair (Himalaya Publishing House, New Delhi)
- **Environmental Biology:** M.P. Arora (Himalaya Publishing House, New Delhi)
- **Environmental Science:** Enger Smith, Smith, W. M. C. Brown (Company Publishing)
- **Principles of Soil Science:** Watt K. E. F. (1973), (McGraw Hill Book Company, New Delhi)
- **Introduction to Environmental Studies:** Turk & Turk

- **General Ecology:** H. D. Kumar (Vikas Publishing house, New Delhi)
- **Elements of Ecology:** Brijgopal, N. Bharadwaj (Vikas Publishing house, New Delhi)
- **Fundamentals of Environmental Science:** G. S. Dahliwal, G. S. Sangha, P. K. ralhan (Kalyani Publishers, New Delhi)
- **Concepts of Ecology:** N. Arumugam (Saras Publication, Kottar, Dist. Kanyakumari)
- **Introduction to Environmental science:** Y Anjaneyulu (B S Publication, Hyderabad)
- **Environmental Chemistry and Analysis:** Prof. M. S. Subramanian, Indian Institute of Technology, Madras.
- **Environmental chemistry:** B K Sharma and H. Kaur, Meerut Krishna Prakashan.

Reference Books:

- **Applications of Environmental Chemistry** by Eugene R. Weiner, CRC Press, LLC
- **Environmental Pollution Analysis**: Khopkar
- **Environmental and Man**: The Chemical Environmental: J. Lenihan and W.W. Fletcher
- **Water Toxicology:** V. V. Metelev, A. I. Kanaev, N. G. Dzasokhova, Amerind Publishing Company, Pvt, Ltd, New Delhi (1971).
- **Water Pollution and Toxicology:** S. K. Shukla & P. R. Srivastava, Commonwealth Publisher, New Delhi (1992).
- **Toxicology – Principles & Methods:** M. A. Subramanian, MJP, Publishers, Chennai (2004).
- **Environmental Pollution Health & Toxicology:** S V S Rana, Narosa Publishing House, New Delhi (2006).
- **Toxicology:** P D Sharma, Rastogi & Company, Meerut (1995).

SENVCP 1201: Practical Based on (SENVCT 1201) Environmental Chemistry (2 cr)

Course pre-requisite:

- Environmental chemists should have a solid background in chemistry, including organic and biochemistry. (A minimum of twelfth or a bachelor's degree is typically required.)

Course objectives:

- To develop an understanding of the interdisciplinary and holistic nature of the environment.
- It will be able to apply previous knowledge on analytical chemistry to environmental processes and samples.
- It will understand the interconnections between different sectors of the environment (soil, water, and atmosphere) and the effect of human activities on the natural chemical processes.

Course outcomes:

- To develop the ability to analyze the air, water and soil quality parameters;
- Environmental chemistry research focuses on chemical processes that affect the sources, composition, reactions, transport, and fates of chemical species in natural environments (air, water, and soil), the impacts of human activities on these environments, and chemical aspects of pollution prevention and contaminant.
- To foster positive attitudes, values and commitment to identifying, solving and preventing environmental problems;

Curriculum Details:

SENVCP1201: Practical Based on SENVCT1201 (60 hrs)

Sr. No	Practical Exercises
1	Estimation of DO/ BOD/COD from water sample.
2	Air Quality Monitoring (sulphur dioxide/ nitrogen oxides/particulate matter in the air)
3	Estimation of any trace elements from provided water sample.
4	Determination of Soil Texture.
5	Study of remedial measures for mitigation of global warming.
6	Determination of Residual chlorine from provided water sample.
7	Estimation of Total Hardness from water sample by E. D. T. A. method.
8	Study of Toxicity of Metals (Hg, Cd, As, Pb)

09	Determination of Total organic matter by ignition method.
10	Determination of soil nutrients (N,P,K)
11	Determination of water holding capacity of soil.
12	Determination of bulk density of soil.
13	Identification and description of Phytoplankton's (any three)
14	Identification and description of Zooplankton's (any three)
15	Field visit and prepare the report

Text Books and Reference Books:

- **Environmental Chemistry:** B.K.Sharma,and H. Kaur,GoelPublishing House.
- **Environmental Chemistry:** AK.De, NewAge International Publishers
- **Environmental Chemistry:** H.V.Jadhav.
- **Practical Methods in Ecology and Environmental Science**: R. K. Trivedy, P. K. Goel, Trisal (Environmental Publication, Karad)
- **Manual of Environmental Pollution Analysis**: N. N. Bandela, Masarat Sultana, Uday P. Patil (Prathivi Publication, Aurangabad)
- **A Manual of Fresh water ecology**: R. Santhanam, P. Velayutham, G. Jegatheesan (Daya Publishing House, Delhi)
- **Physico-Chemical Examination of Water, Sewage & Industrial effluents**: N. Manivasakam (Pragati Prakashan, Meerut)
- **Manual on Water and Waste Water Analysis**: National Environmental Engineering Research Institute, Nagpur
- **Methodology for Water Analysis**: Dr. Mohan S. Kodarkar, (Indian Association of aquatic Biologist's, Hyderabad)
- **Chemical and Biological methods for Water Pollution Studies**: R. K. Trivedy, P. K. Goel (Environmental Publication, Karad)
- **Methods in Environmental Analysis:** Water, Soil, Air P. K. gupta, (Agrobios India, Jodhpur)
- **Chemical methods for Environmental analysis:** Water & Sediments R. Ramesh & M. Anbu (Macmillan India Limited)

SENVCT1202: Water and water resources (2 credits)

Course pre-requisite:

- The course is offered for a student registered for undergraduate programme in the Faculty of Science and Technology who had primary training in the field of Environmental Science

Course objectives:

- To aware about water and water resources and there importance.
- To understand water disputes/ conflicts at national and international level.
- To understand the water/ groundwater quality and pollution problems.

Course outcomes:

- Acquire knowledge about the water resources with its sources and classification
- To recognize the significance of India's water resources and their management.
- Each section facilitates learners' comprehension of the origins, characteristics, and diverse water sources in India. Furthermore, it addresses associated disputes, legislation and agreements.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction**	
	1.1	Sources and classification of water resources (oceans, rivers, lakes and wetlands)	**07**
	1.2	Hydrological cycle; precipitation, runoff, infiltration, evaporation, evapo- transpiration	
	1.3	Surface and groundwater pollution and its problems	
	1.4	Water table; vertical distribution of water; formation and properties of aquifers, river structure and drainage patterns; watershed and drainage basins	
2.0		**Properties of water**	
	2.1	**Physical:** temperature, colour, odour, total dissolved solids and total suspended solids etc	**08**
	2.2	**Chemical:** major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity etc.	
	2.3	**Biological:** phytoplankton, phytobenthic, zooplankton etc	

	2.4	**Microbiological:** e-coil, total coliform etc. Water quality standards in India	
3.0		**Water Resources in India**	**07**
	3.1	Water and groundwater potential in India	
	3.2	Demand for water (agriculture, industrial, domestic)	
	3.3	Overuse and depletion of surface and groundwater resources, Watershed management.	
	3.4	Role of Central groundwater board (CGWB), Groundwater Survey and Development Agency (GSDA) in water resources management at national and state level.	
4.0		**Water Resource Conflicts, Laws & Treaties**	**08**
	4.1	Interstate & Intrastate water resources and sharing problems, case studies on river water disputes in India	
	4.2	International conflicts on water sharing between India and neighbours countries.	
	4.3	National water policy; water pollution (control and prevention) Act 1974	
	4.4	Indus water treaty; Ganges water treaty; River valley projects, National River linking plan: ecological and economic impacts.	
		Total	**30**

Text Books:

1. **Water Supply and Sanitary Engineering:**S. C. Rangwala, R. C. RangwalaCharotar Publishing House Anand.
2. **Environmental Science :** Nabel and Wright , Prentice Hall, New Jersey
3. **Environmental Chemistry:**B. K. Sharma Goel Publishing House, Meerut.
4. **Water and Hydrology :** Peter B. black,
5. **Environmental Science :** Enger Smith, Smith, W. M. C. Brown , Company Publishing
6. **Water Supply** : Alan C. Twort, Don D. Ratnayaka,(IWA Publishing, New Delhi
7. **Water Pollution : B**. K. sharma, Dr. H. Kaur Krishna PrakashanMandir, Meerut
8. **Water Supply and Pollution Control : Warren** Wiessman, Jr. Mark J. Hammer AWL Publishers, California
9. **Water and Waste Water Technology :** Mark J. Hammer, Mark J. hammer Jr. Prentice Hall of India Pvt,Ltd**.,** New Delhi
10. **A textbook of Environmental Studies :** G. R. Chatwal, Harish Sharma, Himalaya Publishing House, New Delhi
11. **Environment Problems & Solutions :** D. K. Asthana, MeeraAsthana, S. Chand& Co., New Delhi,1998
12. **Water Supply and Pollution Control :** Warren Viessman, Jr. Mark J. Hammer, Addision – Wesley California, 1999.
13. **Ecology and Environment:** P. D. Sharma, Rastogi publications, 2012

Reference Books:

1. Environmental Pollution and Health hazards in India: R. Kumar, Efficient Offset Printers New Delhi.
2. Principles of Environmental Science: William P. Cunningham, Marry Ann Cunningham.Tata Mc Graw Publishing Company Ltd. New Delhi.
3.Environmental Encyclopedia: William P Cunningham, Terence H Cooper, Eville Gorham and Malcolm T Hepworth Jaico Publishing Chennai.

SENVCP1202: Practicals based on water and water resources (SENVCT1202) (2 credits) (60 hrs)

Course pre-requisite:

- The course is offered for a student registered for undergraduate programme in the Faculty of Science and Technology who had primary training in the field of Environmental Science at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in Environmental Science as Major subject.

Course objectives:

- To understand the practical procedures of water analysis

Course outcomes:

- Acquire knowledge about the water resources with its sources and Classification
- To know regarding the physico, chemical & Biological properties of water.
- To develop the analytical skills for water quality analysis.

Sr. No	Practical Exercises
1	Determination of Electrical conductivity of water sample.
2	Estimation of chloride from water samples
3	Estimation of calcium from provided water sample.
4	Estimation of magnesium from provided water sample.
5	Visit to any fresh water ecosystem (pond, lake, river, wetlands) and submit the report
6	Estimation of total fixed and volatile solids.
7	Study of settable solids in water
8	Study of Secchi disk method
9	Measure the Redox potential
10	Study of microbiological characteristics of water
11	Measuring rainfall using a simple rain gauge and recording the amount of precipitation collected
12	Field visits and report writing

SENVMT1201: Environmental Biology (2 Credits)

Course Prerequisites:

A basic understanding of science concepts (e.g., biology, chemistry, physics) can be helpful according to several sources. Some courses may suggest prior completion of high school biology or chemistry, as noted by a source but this is not always a requirement.

Course objective: The course objectives often include introducing students to key environmental problems, developing critical thinking skills related to environmental issues, and promoting an understanding of sustainable practices.

Course outcomes: Course outcomes typically involve students being able to understand the natural world, analyze human impacts on the environment, and evaluate potential solutions for environmental problems.

Curriculum details:

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		**Introduction to Environment**	07
	1.1	Scope of Environmental Biology, Ecology as an inter-disciplinary science. Origin of life and speciation. Human Ecology and Settlement.	
	1.2	Multidisciplinary nature of environment, biodiversity conservation	
	1.3	Principles of ecology, scope, components	
	1.4	Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow models, food chains and food webs.	
2.0		**Biogeochemical cycles**	08
	2.1	Definition and introduction of Biogeochemical cycle. Importance of nutrient cycling.	
	2.2	Gaseous cycles: Oxygen cycle, Carbon cycle and Nitrogen cycle	
	2.3	Sedimentary cycles: Phosphorus cycle, Sulphur cycle	
	2.4	Factors affecting on biogeochemical cycles	

3.0		**Biomes**	07
	3.1	Types of biomes: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic.	
	3.2	Biomes: Concept, classification and distribution.	
	3.3	Characteristics of different biomes: Tundra, Taiga, Grassland, Deciduous forest biome, Highland Icy Alpine Biome, Chapparal, Savanna, Tropical Rain forest.	
	3.4	Ecological succession. Species diversity, Concept of ecotone, edge effects, ecological habitats and niche.	
4.0		**Biodiversity and its conservation**	08
	4.1	Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity.	
	4.2	Concept and basis of identification of 'Hotspots'; hotspots in India. Measures of biodiversity.	
	4.3	Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. National parks, Sanctuaries, Protected areas and Sacred groves in India.	
	4.4	Concepts of gene pool, biopiracy and bio-prospecting. Concept of restoration ecology. Extinct, Rare, Endangered and Threatened flora and fauna of India	
		Total	30

References:

1. **Fundamentals of Ecology**: Eugene P. Odum, (Natraj Publishers, Dehradun.)
2. **Principles of Ecology**: P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
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. **Principles of Soil Science**: Watt K. E. F. (1973), (McGraw Hill Book Company, New Delhi)
9. **Introduction to Environmental Studies**: Turk & Turk
11. **General Ecology**: H. D. Kumar (Vikas Publishing house, New Delhi)
12. **Elements of Ecology**: Brijgopal, N. Bharadwaj (Vikas Publishing house, New Delhi)
13. **Fundamentals of Environmental Science**: G. S. Dahliwal, G. S. Sangha, P. K. ralhan (Kalyani Publishers, New Delhi)
14. **Concepts of Ecology**: N. Arumugam (Saras Publication, Kottar, Dist. Kanyakumari)
15. **Introduction to Environmental science**: Y Anjaneyulu (B S Publication, Hyderabad)
16. **Environmental Chemistry and Analysis**: Prof. M. S. Subramanian, Indian Institute of Technology, Madras.
17. **Environmental chemistry**: B K Sharma and H. Kaur, Meerut Krishna Prakasha

SENVMP1201: Practical based on SENVMT1201 Environmental biology (2 credit) (60 hrs)

Sr. No	Practical Exercises
1	Study of Physical Parameters of Pond or Lake Water (Color, Odor, Temperature and Turbidity)
2	Identification and description of Phytoplankton's (Any three)
3	Identification and description of Zooplankton's (Any three)
4	Plankton counting by Sedgwick cell
5	Determination of plant population density
6	Study of Plant Community Using Quadrat Method to Calculate Frequency Percentage of Different Plant Species
7	Study of an Artificial Ecosystem
8	Observation and identification of Microscopic Flora and Fauna
9	Observation and identification of Mascroscopic Flora and Fauna
10	Study of Ecological Adaptations, Morphology, and Anatomy of Leaf and Stem of Xerophytes
11	Preparation of herbarium from collecting and classifying plants specimens for study
12	Visit to Social Forestry Areas/Urban Forestry.
13	Visit to Wildlife Sanctuaries or Forest Ecosystems

References:

01. **Ecology and environment**: P D Sharma, Rastogi publication, Meerut.
02. **Methods in environmental analysis water soil and air**: P K Gupta, Agrobios (India).
03. **Environmental biology and toxicology**: P D Sharma, Rastogi publication, Meerut.
04. **Practical manual in ecology and environmental science**: R K trivedi, P K Goel and C L Trisal, Environmental publication, Karad.
05. **Manual on Water and Waste Water Analysis N**ational Environmental Engineering Research Institute, Nagpur
06. **Methodology for Water Analysis** Dr. Mohan S. Kodarkar, (Indian Association of aquatic Biologist's, Hyderabad)
07. **Chemical and Biological methods for Water Pollution Studies:** R. K. Trivedy, P. K. Goel (Environmental Publication, Karad)
08. **Methods in Environmental Analysis**: Water, Soil, Air P. K. gupta, (Agrobios India, Jodhpur
09. **Chemical methods for Environmental analysis**: Water & Sediments R. Ramesh & M. Anbu (Macmillan India Limited).

SENVGE1201: Water conservation practices (2 credit)

Course pre-requisite:

- The course is offered for a student registered for undergraduate programme in the Faculty of Science and Technology who had primary training in the field of Environmental Science at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in Environmental Science as Major subject.

Course objectives:

- To aware about water and water resources and there importance.
- To understand water conservation practices to sustain water resources.

Course outcomes:

- Acquire knowledge about the water resources with its sources and classification.
- To recognize the significance of India's water resources and their management.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction**	
	1.1	Introduction to water resources, different types of water resources	**07**
	1.2	Water resources and its importance, Global distribution of water.	
	1.3	Hydrological cycle, Conservation of water.	
	1.4	Recycling of water, sustainable water resources management.	
2.0		**Conservation of water resources**	
	2.1	Rainwater harvesting, methods of rooftop rainwater harvesting in urban setting:	**08**
	2.2	Direct method: Storing rain water in tanks for direct use. Indirect methods: Recharge pits, bore wells/dug wells	
	2.3	Groundwater recharge, Recharge trenches, Over use of surface and ground water and control measures.	
	2.4	Overuse and depletion of surface and groundwater resources.	
3.0		**Watershed management**	
	3.1	Watershed concept, types of watershed, key factors of watershed management like size, shape, physiography, drainage, climate etc.	**07**
	3.2	Rain water harvesting in rural setting: Check dams, percolation	

		tanks, gabion structure.	
	3.3	Continuous contour trenches, staggered contour trenches, farm ponds	
	3.4	Watershed modelling, watershed management case studies.	
4.0		**Water Resource planning and management**	
T	**4.1**	National water policy, Interstate & Intrastate Water resources and sharing problems. Surface water and ground water pollution, control measures.	**08**
	4.2	International conflicts on water sharing between India and neighbours countries.	
	4.3	Mission Godavari: Maharashtra government water grid project for drinking water supply - aims and objectives and method of implementation, restoration projects	
	4.4	Indus water treaty; Ganges water treaty; National River linking plan: ecological and economic impacts. Water conservation case studies	
		Total	**30**

Text books:

1) **Water Resources, Conservation and Management**: Chatterjee, S.N.
2) **Groundwater hydrology**: Todd
3) **Watershed management** : J.V.S.Murthy
4) **Applied Hydrogeology**: Fetter.
5) **Water and Hydrology:** Peter B. black,
6) Environmental Science: Enger Smith, Smith, W. M. C. Brown , Company Publishing

Reference books

1. **Environmental Pollution and Health hazards in India:** R. Kumar Efficient Offset Printers New Delhi.

2. **Principles of Environmental Science:** William P. Cunningham, Marry Ann Cunningham, Tata McGraw Publishing Company Ltd. New Delhi.

3. **Environmental Encyclopaedia:** William P Cunningham, Terence H Cooper , Eville Gorham and Malcolm T Hepworth Jaico Publishing Chennai

SENVSC1201: Rain water harvesting (2 credits)

Course pre-requisite:

- The course is offered for a student registered for undergraduate program in the Faculty of Science and Technology who had primary training in the field of Environmental Science at higher secondary school level evident in terms of certificate by CBSC/ICSC/HSC for entry level core courses in Environmental Science as Major subject.
- The students should have basic knowledge of Environment science.

Objectives:

The main objective of course is to improve the awareness and skills of the students about water harvesting - principles, importance and issues. Water harvesting techniques, classification based on source, storage and use. Runoff harvesting

Learning Outcomes

- Acquire the skill of water harvesting
- It helps to get knowledge of watershed and harvesting methods.
- This course gives the skill of harvesting techniques, purpose, design criteria etc.

Curriculum Details:

SENVSC1201: Rain water harvesting (60 hrs)

Sr. No	Practical Exercises
1	Study of different types of farm ponds
2	Computation of storage capacity of embankment type of farm ponds.
3	Design of dugout farm ponds / percolation ponds / nala bunds
4	Design of small earthen embankment
5	Study of software's for design of soil and water conservation structures
6	Study of rainwater harvesting techniques in ancient time
7	Study of rooftop rainwater harvesting.
8	Study of Bhungroo, a unique, innovative and efficient rain water conservation technology
9	Measuring rainfall using a simple rain gauge and recording the amount of precipitation collected
10	Demarcate Climatic divisions of India as per Koppen's classification on India map
11	Demark the pattern of onset of monsoon in India's map
12	Demarcation of rainfed area on india map
13	Visit to watershed and prepare the report

Reference Books:

1. **Manual of Soil and Water Conservation Practices:** Singh Gurmel, C. Venkataraman, G. Sastry and B. P. Joshi. 2004, 6thed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

2. **Principles of Agricultural Engineering:** Michael, A.M. and T.P. Ojha 2003.. Volume II. 4th Edition, Jain Brothers, New Delhi.

3. **Land and Water Management Engineering**: Murthy, V.V.N. 2002.. 3rd Edition, Kalyani Publishers, New Delhi.

4. **Soil and Water Conservation Engineering**: Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993.4th Edition, John Wiley and Sons Inc. New York.

5. **Soil and Waer Conservation Engineering**: Suresh, R. 2014, Standard Publisher Distributors, New Delhi.

6. **Water Harvesting and Recycling: Indian Experiences:** Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. CSWCR & TI, Dehradun, Allied Printers, Dehradun.

7. **Rainwater Harvesting for Agriculture in the Dry Areas**: Theib Y. Oweis, DiterPrinz and Ahmed Y. Hachum. 2012.. CRC Press, Taylor and Francis Group, London.

8. **Water Harvesting – Guidelines to Good Practice Centre for Development and Environment**: Studer Rima Mekdaschi and HanspeterLiniger. 2013. University of Bern Switzerland

9. **Indigenous Practices of Water Management for Sustainable Services:** Behailu, Beshah M.; Pietilä, Pekka E.; Katko, Tapio S. (2016).. SAGE Open, 6(4), 215824401668229

10. **Agricultural Knowledge in Veda:** Damodar, Satavalekar (1923). Swaghyaya Mandal Oudh, Publisher Satara.

11. **Vedic Agricultural Sciences:** Gupta, Devendra Kumar (2011). Delhi- Pratibha Prakashan.

12. **Water Conservation, Management And Water Awareness:** Khanna, Vijay (2013). Delhi - Book House Publishing.

ENVIRONMENTAL SCIENCE- CURRICULUM

B. Sc. SECOND YEAR

SEMESTER – IV

SENVCT1251: Atmosphere and global climate change (2 cr)

Course pre-requisite:

- A course on "Atmosphere and Global Climate Change" typically requires a background in basic science, particularly physics and chemistry, as prerequisites,

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Course objectives:

- To educate students on the structure and dynamics of Earth's atmosphere, the mechanisms driving climate change, and the potential impacts on our planet, enabling them to critically analyze and discuss solutions to mitigate these effects;

Course outcomes:

- It include understanding the greenhouse effect, identifying human-induced factors contributing to climate change, evaluating climate models, and analyzing the potential impacts on ecosystems and human societies.
- Understanding natural climatic variability in order to recognize human induced climate change, Definitions of terms related to climate change

Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction to the Atmosphere**	**07**
	1.1	Evolution of Atmosphere; Atmospheric composition.	
	1.2	Earth heat budget; Earth energy balance, Thermodynamics.	
	1.3	Particles ions and radicals in atmosphere, movements of air masses	
	1.4	Forms of energy, Energy transfer in Atmosphere, chemical and photochemical reactions in the atmosphere.	
2.0		**Climate change and its factors**	**08**
	2.1	Concepts of climate change; causes of climate change	
	2.2	Natural factors: Continental drift, variation of earth's orbit, volcanic activity, ocean current.	
	2.3	Anthropogenic factors**:** Transportation, Electricity generation, Deforestation, Agriculture, Industry & manufacturing.	
	2.4	Earth mechanism and global climate, EL NINO phenomenon.	

3.0		**Impact of Climate change**	
	3.1	Environmental Impacts**:** Rise in atmospheric temperature; Rise in sea level, Biodiversity Loss, Ocean warming; ocean acidification, O_3 depletion, global warming, Green house effect.	**07**
	3.2	Social impacts: Food Insecurity, Health issues, displacement & migration, Water scarcity, economic impacts.	
	3.3	Specific Regional Impacts: Arctic, developing countries, Coastal Areas.	
	3.4	Concept of carbon credits and carbon trading, Role of agricultural land in carbon sequestration.	
4.0		**Environmental conventions on climate change**	
	4.1	Montreal protocol, (1987), Kigali amendment (2016)	**08**
	4.2	Kyoto protocol, (1997), Vienna convention, (1985), Nairobi Declaration 1982, 1st Earth Summit Rio 1992, Kyoto Protocol 1997, Copenhagen Summit 2008,	
	4.3	Stockholm Convention (POPs), (2001), Durban Summit2011, Paris Agreement 2015.	
	4.4	Convention on biological diversity, (1992), Intergovernmental Panels working towards mitigating, Climate Change –IPCC, UNFCCC.	
		Total	**30**

TextBooks:

1. **Air Pollution and its control**: Sumitmalhotra (Pointer publishers, Jaipur)
2. **Air Pollution**: M. N. Rao (Tata McGraw – Hill publishing company, New Delhi)
3. **Air Pollution**: B. K. Sharma, H. Kaur (KrishnaPrakashan media, Meerut)
4. **Air Pollution**: S. K. Agarawal(A. P. H. Publishing corporation, New Delhi)
5. **Air Pollution**: V. P. Kudesia(PragatiPrakashan, Meerut).
6. **Environmental Chemistry**: B. K. Sharma & H. Kaur Pragati Publication, Meerut
7. **Atmosphere, Weather & Climate**: K. Sidhanatha; Kisalaya Publications, Pvt. Ltd.
8. **Fundamentals of Environmental Science**: G. S.Dahliwal, G. S. Sangha, P. K. Ralhan, Kalyani Publishers, New Delhi.
09. **Textbook of Environmental Studies for Undergraduate Courses**: Erach Bharucha (Universities Press), 2013.
10. **Introduction to Environmental Science**: Y. Anjaneyulu (B.S. Publication), 2008.

11. **Environmental Science**: UGC NET/SET (Danika Publishing Company), 2018.

12. **Environmental chemistry**: A. K. DE. 7TH edition, NEW age international publisher, New Delhi.

13. **Environmental Science:** Anil Tyagi & Virendra Singh, Danika Publishing Company, New Delhi.

14. **The Atmosphere**: Lutgens & amp; Tarbuck

15. **IPCC Reports on Climate Change**

16. **Fundamentals of Environmental Science**: A Global Concern – Cunningham &amp Cunningham

17. **Environmental Science**: Daniel Chiras (Case Studies)

SENVCP1251: Practical Based on Atmosphere and global climate change SENVCT1251 (2 credits)

Course prerequisites:

- Familiarity with chemical reactions, gas laws, and the properties of greenhouse gases.
- Understanding basic weather patterns, atmospheric circulation, and weather forecasting principles.
- Ability to analyze and interpret climate data sets.

Course objective:

- Explain the concept of climate change. Consider the effects of climate change on extreme weather. Recognize ways that they can lower their impact on the environment at classroom and laboratory.

Course outcomes:

- Learners can describe climate change and understand the main terminology used. Learners can understand how climate change is negatively affecting India. Learners can explain how they can contribute to achieving the Climate Action Goal.

Sr. No.	Practical Exercises
1	Study of Micro-meteorological instruments (Rain Gauge, Psychrometer, Wind Anemometer, Lux meter, Barometer).
2	Study of Rotorod Air Sampler and Tilak Air Sampler.
3	Study of Collection mechanism (Adsorption and Absorption) and sampling devices for gaseous pollutants
4	Measurement of rain falls by rain gauge.
5	Determination of wind velocity by anemometer.

6	Determination of wind direction by wind vane.
7	Determination of atmospheric pressure by using Barometer.
8	Dust fall measurement by tiles exposure method.
9	Study the effect of SO_2 on Plants.
10	Study the effect of H_2S on Plants.
11	Interpretation of wind rose diagram.
12	Determination of Air pollution index.
13	To demonstrate the global warming potential of carbon dioxide (CO_2) gas in the Earth's atmosphere**.**
14	Field visit and preparation of report

SENVCT 1252: BIODIVERSITY AND CONSERVATION (2 CR)

Course Pre-requisite:

This paper deals with fundamental knowledge of biodiversity at local, regional, national and global level. It also provides scientific knowledge of assessing and using conservation techniques to conserve biodiversity.

Course Objectives:

- To get knowledge on Biodiversity status on global level
- To study Biodiversity wealth of India.
- To study conservative measures of Biodiversity.

Course Outcomes:

- Get a deep knowledge on biodiversity richness in global scale.
- Assess the biodiversity wealth of our Nation.
- Analyze various threats to our Biodiversity.
- Trained effectively and scientifically to conserve biodiversity.

Curriculum details:

Module No	Unit No.	Topic	Hrs. Required
1.0		**Introduction-**	
	1.1	Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects.	07
	1.2	Bio-geographic classification of India. Basic concepts of conservation biology.	
	1.3	Conservation of genetic diversity, species diversity, ecosystem diversity,	
	1.4	Relevance of ecosystem diversity as well as services in conservation	
2.0		**Bio diversity Values**	
	2.1	Values of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information.	08
	2.2	Key stone species, IUCN threatened categorization, Methodology and Preparation of PBR. Fauna and Flora	

		Documentation.	
	2.3	Biodiversity at global, national and local levels, India as a Mega Diversity	
	2.4	Hotspots of Biodiversity: Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka.	
3.0		**Threats to Bio diversity**	
	3.1	Threats to Biodiversity- Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife.	08
	3.2	Rare species, genetic diversity of rare species, habitat loss and fragmentation.	
	3.3	Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species.	
	3.4	Human factors: social factors, economics, politics and action. Man-wildlife conflicts. Endangered and endemic species of India,	
4.0		**Conservation of Biodiversity**	
	4.1	In-situ conservation- environmental assessment, protected areas-biosphere reserves, national parks, sanctuaries	07
	4.2	Ex situ conservation – Botanical Gardens, Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation.	
	4.3	Strategies for Conservation: Top-down and bottom- up protocols for conservation, Ecoplanning responsibilities	
	4.4	Biological Diversity Act 2002.	

Text books:

1. **An Advanced text book on Biodiversity- principles and Practice:** Krishnamoorthy, K.V (2004) Oxford and IBH publishing company Pvt. Ltd. New Delhi.
2. **Plant Biotechnology and Biodiversity conservation**: Kumar, U. and Sharma, A.K (2008) Agrobios India.
3. **Biodiversity, Ecosystem Functioning, and Human Wellbeing An Ecological and Economic Perspective:** Shahid N., Daniel E. Bunker, A.H., Michel L. and Charles Perrings (2009)., Oxford University Press, New York.
4. **Ecology and Environmental Sciences :** Sharma P.D. (2003)., Rastogi Publications, Meerut, India
5. **Biodiversity: Implications for global security**: Swaminathan, M.N. & Jain, R.S. (1982), Macmillan,1982.
6. **Indian Wildlife Resources Ecology and Development Sharma**: B.D Daya Publishing House, Delhi 1999.

7. **Wildlife Ecology, Conservation and Management Sinclair**: Anthony R.E., Fryxell, John M. and Caughly, Graeme Blackwell Publishing, U.S.A. 2006.
8. **Zoogeography of India and Asia:** Tiwari, S.K. CBS Publisher and Distributors, New Delhi.
9. **Introduction to environmental science:** Y. Anjaneyulu (2014), BS Publication, Hyderabad.

Reference Books:

1. **Global Biodiversity Assessment**: Heywood, V.H. & Watson, R.T. (1995).
2. **The Biodiversity Crisis**: Losing What Counts: Novacek, M. J. (ed.) (2001). New York: American Museum of Natural History Books.
3. **Diversity of Life:** Wilson E.D (1999). W.W. Norton, USA.
4. **Biodiversity:** Leveque, C. & J. Mounolou (2003). New York: John Wiley.
5. **Diversity of Life**: Margulis, L., Dolan, Delisle, K., Lyons, C. The Illustrated Guide to the Five Kingdoms. Sudbury: Jones & Bartlett Publishers.
6. **Environmental law in India**: Leelakrishnan 6th edition, Lexis Nexis Publication Hariyana India -2021.

SENVCP1252: Practical Based on biodiversity and conservation SENVCT1252 (2 cr)

Sr. No.	Practical Exercises
1	To determine leaf area index
2	To study the species richness of animals in region/ Campus
3	To study species richness of plants in region /campus
4	To study the local endangered species of Plant
5	Field survey for floral species diversity.
6	Field survey for aquatic bio diversity specially lake (Plant).
7	Field survey for aquatic bio diversity specially river (plant)
8	Field survey for aquatic bio diversity specially river (Animal)
9	Field survey for soil microbial diversity.
10	Field survey for fungal biodiversity
11	Field survey for Aquatic bio diversity specially lake (animal)
12	To study the local endangered species of animal
13	Field visit to national park/sanctuaries and prepare the report
14	To study the Conservation Methods like in-situ and ex-situ

SENVMT1251: Introduction to Pollution (2 Credits)

Course Prerequisites:

- Basic understanding of environmental studies: Familiarity with ecological concepts and environmental issues.
- Basic chemistry knowledge: Understanding of chemical reactions, pollutants, and their properties.

Course objective:

- Identify types of pollutants and their sources: Recognize air, water, soil, and other pollutants, and their origins.
- Analyze the effects of pollution: Understand the impact on human health, ecosystems, and the environment.
- Explore mitigation and control strategies: Learn about pollution prevention, control techniques, and remediation methods.

Course outcomes:

A course on environmental pollution aims to equip students with the knowledge and skills to understand and address various pollution issues. Upon completion, students should be able to comprehend the sources, impacts, and mitigation strategies for different types of pollution, including air, water, soil, and noise pollution.

Curriculum details:

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		**Air pollution**	07
	1.1	Air pollution introduction; classification of pollutants.	
	1.2	sources and types of pollutants (primary and secondary),	
	1.3	Effects pollutants on human health (NOx, SOx, PM, CO, CO_2, hydrocarbons and VOCs) and control measures,	
	1.4	Indoor air pollution: sources and effects on human health	
2.0		**Water pollution**	08
	2.1	Sources of surface and groundwater pollution; water quality parameters: cations, anions and COD, BOD, DO and their drinking standards.	
	2.2	Organic waste and water pollution; Eutrophication	
	2.3	Effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases.	

3.0		**Soil pollution**	07
	3.1	Importance of soil, definition and composition of soil.	
	3.2	Sources of soil pollution, soil sediments as pollutants, detrimental effects of soil pollutants.	
	3.3	Soil erosion; measure to control erosion, sedimentation and pollution.	
4.0		**Noise pollution**	08
	4.1	Noise pollution-Introduction, sources of noise; frequency, intensity.	
	4.2	Permissible ambient noise levels; speech interference.	
	4.3	Effects of noise pollution: physiological and behavioural effects, biological effects.	
	4.4	Noise & vibration control: Barrier ,enclosure, vibration dumping, silencer	
		Total	30

Text books/Reference books:

1. **Fundamentals of Ecology:** Eugene P. Odum, (Natraj Publishers, Dehradun.)
2. **Principles of Ecology**: P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
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. **Principles of Soil Science**: Watt K. E. F. (1973), (McGraw Hill Book Company, New Delhi)
9. **Introduction to Environmental Studies**: Turk & Turk
11. **General Ecology:** H. D. Kumar (Vikas Publishing house, New Delhi)
12. **Elements of Ecology:** Brijgopal, N. Bharadwaj (Vikas Publishing house, New Delhi)
13. **Fundamentals of Environmental Science:** G. S. Dahliwal, G. S. Sangha, P. K. ralhan (Kalyani Publishers, New Delhi)
15. **Concepts of Ecology:** N. Arumugam (Saras Publication, Kottar, Dist. Kanyakumari)
16. **Introduction to Environmental science:** Y Anjaneyulu (B S Publication, Hyderabad)
17. **Environmental Chemistry and Analysis:** Prof. M. S. Subramanian, Indian Institute of Technology, Madras.
18. **Environmental chemistry**: B K Sharma and H. Kaur, Meerut Krishna Prakashan.

SENVMP1251: Practical based on SENVMT1251 Introduction to pollution

Sr.No.	Practical Exercises
1	Estimation of Dissolved oxygen from water by Winkler's method
2	Estimation of Alkalinity of provided water sample
3	Estimation of Acidity from provided water sample
4	Determination of Residual chlorine from provided water sample
5	Estimation of total hardness from water sample by E. D. T. A. method
8	Determination of total dissolved solids form provided water sample
9	Determination of Soil pH from provided soil sample
10	Study the effect of SO_2 on Plants
11	Study the effect of H_2S on Plants
12	Interpretation of wind rose diagram
13	Determination of Noise level by dB meter
14	To study National and International water quality standard
15	Field visit

References:

01. **Ecology and environment:** P D Sharma, Rastogi publication, Meerut.
02. **Methods in environmental analysis water soil and air**: P K Gupta, Agrobios (India).
03. **Environmental biology and toxicology**: P D Sharma, Rastogi publication, Meerut.
04. **Practical manual in ecology and environmental science**: R K trivedi, P K Goel and C L Trisal, Environmental publication, Karad.
05. **Manual on Water and Waste Water Analysis**: National Environmental Engineering Research Institute, Nagpur
06. **Methodology for Water Analysis:** Dr. Mohan S. Kodarkar, (Indian Association of aquatic Biologist's, Hyderabad)
07. **Chemical and Biological methods for Water Pollution Studies:** R. K. Trivedy, P. K. Goel (Environmental Publication, Karad)
08. **Methods in Environmental Analysis: Water, Soil, Air: P. K.** Gupta, (Agrobios India, Jodhpur)
09. **Chemical methods for Environmental analysis**: Water & Sediments R. Ramesh & M. Anbu (Macmillan India Limited).

SENVGE1251: Climate change (2 credits)

Course pre-requisite:

- The course is offered for a student registered for undergraduate programme in the Faculty of Science and Technology who had primary training in the field of Environmental Science at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in Environmental Science as Major subject.
- A course on "Atmosphere and Global Climate Change" typically requires a background in basic science, particularly physics and chemistry, as prerequisites,

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Course objectives:

- To educate students on the structure and dynamics of Earth's atmosphere, the mechanisms driving climate change, and the potential impacts on our planet, enabling them to critically analyze and discuss solutions to mitigate these effects;

Course outcomes:

- It include understanding the greenhouse effect, identifying human-induced factors contributing to climate change, evaluating climate models, and analyzing the potential impacts on ecosystems and human societies.

Curriculum Details

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction of atmosphere**	**07**
	1.1	Evolution of Atmosphere; Atmospheric composition.	
	1.2	Earth heat budget; Earth energy balance, Thermodynamics.	
	1.3	Particles ions and radicals in atmosphere, movements of air masses	
	1.4	Forms of energy, Energy transfer in Atmosphere, chemical and photochemical reactions in the atmosphere.	
2.0		**Climate change and its factors**	**08**
	2.1	Concepts of climate change; causes of climate change	
	2.2	Natural factors: Continental drift, variation of earth's orbit, volcanic activity, ocean current.	
	2.3	Anthropogenic factors**:** Deforestation, Agriculture, Industry & manufacturing.	
	2.4	Earth mechanism and global climate, EL NINO phenomenon.	
3.0		**Impact of Climate change**	**07**

	3.1	Environmental Impacts**:** Rise in atmospheric temperature; Rise in sea level, Biodiversity Loss, Ocean warming; ocean acidification,	
	3.2	Social impacts: Food Insecurity, Health issues, displacement & migration, Water scarcity, economic impacts.	
	3.3	Specific Regional Impacts: Arctic, developing countries, Coastal Areas.	
	3.4	Ozone depletion, global warming, Green house effect.	
4.0		**Environmental conventions on climate change**	**08**
	4.1	Montreal protocol, (1987), Kigali amendment (2016)	
	4.2	Kyoto protocol, (1997), Vienna convention, (1985), Nairobi Declaration 1982, 1st Earth Summit Rio 1992,	
	4.3	Convention on biological diversity, (1992), Copenhagen Summit 2008	
	4.4	Role of Intergovernmental Panels working towards mitigating, Climate Change –IPCC, United Nations Framework Convention on Climate Change (UNFCCC).	
		Total	**30**

Text Books:

1. **Air Pollution and its control:** Sumit malhotra (Pointer publishers, Jaipur)

2. **Air Pollution**: M. N. Rao (Tata McGraw – Hill publishing company, New Delhi)

3. **Air Pollution:** B. K. Sharma, H. Kaur (Krishna Prakashan media, Meerut)

4. **Air Pollution**: S. K. Agarawal(A. P. H. Publishing corporation, New Delhi)

5. **Air Pollution:** V. P. Kudesia(PragatiPrakashan, Meerut).

6. **Environmental Chemistry:** B. K. Sharma & H. Kaur Pragati Publication, Meerut

7. **Atmosphere, Weather & Climate:** K. Sidhanatha; Kisalaya Publications, Pvt. Ltd.

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:** Erach Bharucha (Universities Press), 2013.

10. **Introduction to Environmental Science:** Y. Anjaneyulu (B.S. Publication), 2008.

11. **Environmental Science UGC NET/SET:** (Danika Publishing Company), 2018.

SENVSC12151: Sustainable Agricultural practices (2 cr)

Course pre-requisite:

- The course is offered for a student registered for undergraduate programme in the Faculty of Science and Technology who had primary training in the field of Environmental Science at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in Environmental Science as Major subject.

- The students should have basic knowledge of agricultural practices and Major crops and their varieties, sowing and harvesting time (likely duration each crop occupying in a particular area).

Course objectives:

- To aware about sustainable agricultural practices.
- To understand about different cropping pattern and fertilizer applications.

Course outcomes:

- Students will prepare cropping plans for different farming situations (irrigated and rainfed/ dry lands.
- Students will understand water harvesting methods, precise application of fertilizers and soil pollution control methods.

SENVSC1251: Practical Based on Sustainable agricultural practices (2 Cr)

Sr. No.	Practical Exercises
1	Classification of Farming systems and factors affecting it.
2	Study of water saving technology and their efficiencies.
3	Study of efficient Cropping systems and allied enterprises.
4	Study of integrated Farming System and visit and prepare the report.
5	Development of site specific IFS models for different Agro climatic zones, its resource use efficiency and optimization technique
6	Study of farming systems in relation to environment, its resource cycling and flow of energy
7	Soil/water quality testing for crop suitability.
8	Visit to Organic Farm to study the various components and their utilization
9	Study of Preparation methods for Enriched compost like compost, vermicomposting etc
10	Study of crop residue management and preparation of green manure.
11	Study of indigenous technology knowledge (ITK) for nutrient, insect, disease and weed management.

12	Study of Quality aspects: Grading, Packing, Handling.
13	Study of biogas plant and its applications
14	Preparation of different integrated farming model (IFM) for dry/irrigated land
15	Use of ICT and mechanical instruments for agriculture
	Total

References:

1) **Cropping systems Theory and Practice:** Chatterjee B.N. and Maiti S.

2) **Cropping Systems in Tropics Principles and practices:** Palanniappan S.P.

3) **Organic Farming for Sustainable Agriculture:** Dahama A. K. Agrobios Publication.

4) **Organic Farming: Theory and Practices:** Palanippan, S.P. and Anaadurai, K.

5) **Organic Farming in India, Problems and Prospects:** Thapa, U. and Tripathi, P.

6) **Trends in Organic Farming in India:** Agrobios Publication

7) **Handbook of Organic Farming:** Edited and published by: Forum CSRD

8) **Recent Developments in Organic farming:** Gulati and Barik

Guidelines for the Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks) of theory and practical courses:

i. **For Theory Course:** CA shall form 20% of the Maximum Marks and shall be carried out over the entire semester. It shall be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (on remaining 40% syllabus) and average of the marks scored by a student in these two tests of a particular paper shall be taken as the **CA** score.

ii. **For Practical Course:** CA score of the practical course shall be marks scored by a student in the internal practical examination conducted by the concerned teacher.

B. End Semester Assessment (80% of the Maximum Marks) of theory and practical courses:

(For illustration a paper of 02 credits, 50 marks has been considered and shall be modified appropriately depending upon credits of the individual paper)

Question Paper Pattern of the ESA:

i. ESA Question paper shall consist 6 questions, each of 10 marks

ii. Question No.1 shall be compulsory and shall be based on the entire syllabus

iii. Students shall have to solve ***ANY THREE***of the remaining Five Questions (i.e. from question 2 to 6)

iv. Students shall have to solve a TOTAL of 4 Questions.

C. Assessment of On Job Training (OJT) Course (for 04 credits):

a. Continuous assessment part (**40%, 40 marks out of 100**) of this course shall be done by the mentor of the student, where he /she is supposed to complete his On Job Training. This shall be based on the regularity, participation and performance of the students at the place of OJT.

b. Semester End Assessment (ESA) (**60% of the total marks, 60 marks out of 100**) of this course shall be done by a panel of examiners in two parts

i. based on the work report submitted by the student (**50%i.e. 30 marks)** and

ii. **Remaining 50%**(30 marks) shall be based on his presentation and viva-voce on the work carried to be assessed by the panel of examiners. This assessment shall be done along with practical examinations of respective courses / subjects.

D. Assessment of Field Project (FP) and Research Project (RP) (e.g. for 02 credits)

a. Continuous assessment part (**40%, 20 marks out of 50**) of this course shall be done by the mentor of the student and shall be based on regularity, experimental work and performance of the student.

b. Semester End Assessment (ESA) (**60% of the total marks, 30 marks out of 50**) of this course shall be done shall be done by a panel of examiners in two parts

i. based on the work report submitted by the student (**50% i.e. 30 marks)** and

ii. **Remaining 50%** (30 marks) shall be based on his presentation and viva-voce on the work carried out by the student. This assessment shall be done along with practical examinations of therespective courses / subjects.

E. Assessment of Co-Curricular courses (CCC):

a. Assessment of the CCC course shall be done by the respective course coordinator as a part of CA and be based on the regularity, performance of a student and his participation in various activities as prescribed in the regulations prepared in this regard.

b. The End Semester Assessment (ESA) of the CCC courses shall be done as per the regulations prepared in this regard and shall be done on the basis of the write-up, presentation by the student on the activities that he has carried out in a semester.

c. Students shall have freedom to opt for more than one CCC courses. However, score of the best performing CC shall be considered for preparing his result.

F. Syllabi, Teaching and Examination Scheme for the courses in Column 7 and Column 8 (AEC, VEC, IKS, CI, EVS, CCCs, etc.) shall be common for all the students from different faculties.

Note:Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course45 lectures.