Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/ Sci./College/NEP-2020/104/2024

It is hereby inform to all concerned that, In continuation circular No.SU./Revised B.Sc./NEP/72/2024/25588-96 dated 29.04.2024, the revised syllabi prepared by the Board of Studies/Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technolgy, the Academic Council at its meeting held on 08 April 2024 has accepted **the following Revised B.Sc. Course Structure & Curriculum** as per direction by the State Government dated on 13 March 2024 under the Faculty of Science & Technology (as per National Education Policy – 2020) run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1	Physics	Ist and IInd semester
2	Instrumentation Practice	Ist and IInd semester
3	Electronics	Ist and IInd semester
4	Mathematics	Ist and IInd semester
5	Industrial Chemistry	Ist and IInd semester
6	Agrochemical Fertilizer	Ist and IInd semester
7	Horticulture	Ist and IInd semester
8	Biochemistry	Ist and IInd semester
9	Botany	Ist and IInd semester
10	Zoology	Ist and IInd semester
11	Biotechnology	Ist and IInd semester
12	bioinformatics	Ist and IInd semester
13	Microbiology	Ist and IInd semester
14	Dairy Science & TEchnology	Ist and IInd semester
15	Statistics	Ist and IInd semester
16	computer Science	Ist and IInd semester
17	Geology	Ist and IInd semester
18	Chemistry	Ist and IInd semester
19	Analytical Chemistry	Ist and IInd semester
20.	Polymer Chemistry	Ist and IInd semester
21.	Environmental Science	Ist and IInd semester
22.	Fishery Science	Ist and IInd semester

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This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar
-431 004.
REF.NO. SU/SCI./2024/27128-35
Date:-27.05.2024.

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

B.Sc. Degree Programme

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

Course Structure and Syllabus for B. Sc. First Year

(Revised)

(AS PER NEP-2020)

Subject (Major): Environmental Science.

Effective from 2024-25

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Structure of B. Sc. (Three / Four Years Honours / Honours with Research Degree) Programme with Multiple Entry and Exit Options

Subject (Major): Environmental Science

BSc First Year: 1st Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1	DSC-1	Foundation of	2		2		
Mandatory		Environment					2+2 = 4
	DSC-2	Lab Course-I Practical based on DSC-1		4		2	
Major (Core) M2	DSC-1		2		2		
Mandatory	DSC-2	Practical based on DSC-1		4		2	2+2 = 4
Major (Core) M3	DSC-1		2		2		
Mandatory	DSC-2	Practical based on DSC-1		4		2	2+2 = 4
Generic / Open Elective (GE/OE)							
(Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-1	(To be chosen from other faculty)	2		2		2
SEC (Skill Enhancement Courses)	SEC-1A	Life Cycle Causting of Waste Water Treatment	1		1		2
	SEC-1B	E -Waste Management					
(Choose any one from pool of courses)	SEC-2A	Lab Course-II (Practicals based on SEC-1A)		2		1	
	SEC-2B	Lab Course-II (Practicals based on SEC-1B)					
	AEC-1	**English** (Common for all the faculty)	2		2		
	IKS-1	(Choose any one from pool of courses)	2		2		2+2 =4
AEC, VEC, IKS							
OJT/ FP/CEP/CC/RP	CC-1	Health and Wellness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**

GE / OE-1: Ecology & Ecosystem Management (Course for other faculty)

BSc First Year: 2nd Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory	DSC-3	Pollutional Aspects of Environment	2		2		2+2 = 4
	DSC-4	Lab Course-III (Practical based on DSC-3)		4		2	
Major (Core) M2 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major (Core) M3 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-2	(To be chosen from other faculty)	2		2		2
VSC (Vocational Skill Courses) (Choose any one from pool of courses)	VSC-1A	Sustainable & Millennium Developmental Goals	1		1		2
	VSC-1A	Municipal Solid Waste Management					
	VSC-2A	Lab Course IV (Practicals based on VSC-1A)		2		1	
	VSC-2B	Lab Course-IV (Practicals based on VSC-1B)					
AEC, VEC, IKS	AEC-2	**English** (Common for all the faculty)	2		2		2+2 =4
	VEC-1	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	CC-2	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

GE/OE-2 : Microbial Aspects of Environment (Course for other faculty)

Students will have to choose any three subjects as a **Major 1, Major 2, Major 3,** from Basket 1 under the Faculty of Science and Technology.

Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year. Students will have to select / declare choice of one subject **as a major subject** in the beginning of second year **out of three major options M1, M2 and M3 (which were opted in the first year).**

Detailed Illustration of Courses included in 1st and 2nd semester:

1) **Major** (Core) subject are mandatory.

   DSC-1 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-2 : This is a 2 credit practical course based on DSC-1
   DSC-3 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-4 : This is a 2 credit practical course based on DSC-3

2) **Generic / Open Elective (GE/OE)**: (Needs to be chosen (any one) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

   GE/OE -1 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.
   GE/OE -2 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

3) **SEC** (Skill Enhancement Courses) : Choose any one from pool of courses. These courses needs to be designed to enhance the technical skills of the students in specific area.
   SEC-1 : This is a 1 credit theory course to enhance the technical skills of the students in specific area.
   SEC-2 : This is a 1 credit practical course based on SEC-1.

4) **VSC** (Vocational Skill Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

   VSC-1 : This is a 1 credit theory course based Hands on Training corresponding to Major (core) subject.
   VSC-2 : This is a 1 credit practical course based on VSC-1

5) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills. It will be common for all the faculty.

   AEC-1 : English
   This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.
   AEC-2 : English
   This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

6) **IKS** (Indian Knowledge System) : The courses related to traditional and ancient culture of India will be included in this section. The respective college will have to choose one of the courses from the pool of courses designed by the University.

IKS-1 : To be chosen from the pool of courses designed by the University
This is a 2 credit theory course based on Indian Knowledge System. It will be common for all the faculty

7) **VEC** (Value Education Courses): The courses such as understanding India, Environmental Science / Education, Digital and Technological solutions etc will be part of Value Education Courses.

VEC-1 : Constitution of India
This is a 2 credit theory course based on value education. It will be common for all the faculty

8) **CC** (Curricular Courses): The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Preforming Arts.

CC-1 : Health and Wellness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

CC-2 : Yoga education / Sports and Fitness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

General Guidelines for Course Selection

1) The Major subject is the discipline or course of main focus, bachelors degree shall be awarded in that discipline / subject.
2) Students will have to choose any three subjects as a Major 1, Major 2, Major 3, from **Basket 1** under the Faculty of Science and Technology (based on the available options in the respective college).
3) Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year.
4) In the beginning of second year, students will have to select / declare choice of **one major subject** and **one minor subject** from three major options **M1, M2 and M3 (which were opted in the first year)**
5) Once the students finalize their **Major Subject** and **Minor Subject** in the beginning of the second year of the programme, they shall pursue their further education in that particular subject as their **Major and Minor** subjects. Therefore, from second year onwards curriculum of the Major and Minor subjects shall be different.
6) Students are required to select **Minor subject** from **other discipline of the same faculty**
7) Students are required to select **Generic /Open Elective** (vertical 3 in the credit framework) **compulsorily from the faculty different than that of their Major / Minor subjects (from Basket 2 of other faculty).**
8) Vocational Skill Courses and Skill Enhancement Courses (VSC and SEC) shall be related to the Major subject
9) Curriculum of Ability Enhancement Courses (AEC), Value Education Courses (VEC), Indian Knowledge System (IKS) **(Basket 3)**, and Co-curricular Courses (CC) will be provided by the University separately.

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

- **PO2. Environment and sustainability**: Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.

- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.

- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO6. Project management and finance**: Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

- **PO7. Life-long learning**: Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs):

Following are the PSOs for Environmental Science Major.

PSO1. **Domain knowledge:** Apply the knowledge of environmental fundamental and advanced areas of Environmental Science to provide comprehensive solution of problems of complex environment.

PSO2. **Problem Analysis:** Identify environmental problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using prominent principles of Environmental Science.

PSO3. **Design Development of solutions:** Design/ develop solutions for problems at varied complexity in various areas of Environmental Science to address changing challenges put forward by market demand/ stakeholder.

PSO4. **Conduct Investigation of current complex environmental problems:** Use established knowledge and methods to design of experiments, analyze resulting data and interpret the same to provide valid conclusions from environmental problems along with solutions.

PSO5. **Modern tools:** Create, select, and apply appropriate techniques, by using available resources and modern innovated relevant instruments and tools for reduction or solving the current environmental problems.

B. Sc Environmental Science
Preamble

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, loss of forest, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and world Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorance about environment issues. Therefore, the environmental science study is an important component and given much attention. Inspite of the deteriorating status of the environment, study of environmental science has so far not received adequate attention in our academic programmes in recent past of 3 to 4 decades. Hence by considering importance of subject the Environmental Studies has adopted and implemented for all faculties and formulated an undergraduate degree course on Environmental science for graduation.

The course curriculum is both inclusive and interdisciplinary and draws content from different allied disciplines. Ideally, an undergraduate programme in environmental science should equally focus equally on theory and practice so that students are able to pick up necessary skills enabling them to find gainful employment in the job market. Therefore, a number of skill-based courses have been identified and made a part of the curriculum. Various core courses have been made

appealing from a practitioner's point of view. Hopefully, a student with a B.Sc. Environmental Science (Hons.) degree, should be equipped to meet the requirements of job market. Also, there is sufficient content for those who wish to continue academic life at the university beyond undergraduate level.

The need for an honours course in Environmental Sciences is necessitated by the acceptability of the subject by young students and also from the point of view of job market opportunity it proffers them as compared to those from pure academic disciplines. A latent demand for the subject exists in our country and we must meet the aspirations of young students. It is also expected that Environmental Science graduates, in the long run, will also significantly contribute to the vision of 'zero defect, zero effect' policy initiative of Government of India.

B.Sc. Environmental Science (Hons.) programme, like all other undergraduate courses shall comprise of 110 credits distributed in theory and practical components, and papers to be completed in three years/six semesters. The credits were distributed as compulsory major courses and elective minor courses along with Ability Enhancement Courses & Skill Enhancement Courses.

Semester - I

B.Sc First Year ; Semester – I;
Subject: Environmental Science
Discipline Specific Course (DSC)
DSC-1: Foundation of Environment
(Compulsory Theory Course with 02 credits ; 30 Contact Hours)

Course Objectives

Students will be able to know

1. stimulate interest in the environment;
2. develop an understanding of the interdisciplinary and holistic nature of the environment;
3. develop knowledge and understanding of environmental components and principles.
4. develop the ability to identify critical issues from the field of Environmental science.

Course Outcome

After completion of course, students will be able to:

1. develop the ability to communicate environmental information and ideas logically and
   concisely in a variety of forms;
2. provide an understanding of interactions between the components of environment;
3. increase an awareness of the importance of living in harmony with the environment;

Unit-I: - Principles of Environmental Science: 10hrs

Scope and importance of environmental science; Fundamental principles; Multidisciplinary nature of environmental science; Physico-chemical and biological factors in the environment;
Social environment; Nature of man and environment interactions; Human population growth and environmental carrying capacity.

Unit II: - Environmental processes and its components: 10hrs.

Environmental processes-Movement of lithosphere plates; earthquakes; volcanic activities; gravitational and magnetic fields of the earth; importance of the gravitational and geomagnetic field.

The structure and composition biosphere; Biogeochemical and nutrient cycles- nitrogen, carbon, oxygen. Energy in ecological system, Terrestrial ecosystems, Aquatic ecosystems

Unit-III: Ecology and Ecosystems: 10 hrs

Ecology-Definition and scope,
Ecosystem-Concept and structure of ecosystem, Functions of ecosystem, Biotic Components of ecosystem (producer, consumer and decomposer), Abiotic components of ecosystem (Wind, Temperature, Soil, Minerals, Nutrients, CO_2, Solar radiation, etc), A biotic and biotic components, , Concept of productivity,

Books Recommended:

1. Principles of Ecology-P.S.Verma and V.K. Agarwal

2. Fundamentals of Ecology-Odum E.P.
3. Principles of Environmental Science-Wart K.E.F.(1973) Mc Graw Hill book Company.
4. Ecology and Environments-P.D.Sharma
5. Elements of Ecology-P.D.Sharma
6. Ecology-M.P.Arora
7. Basic Ecology-E.P. Odum
8. Concept of Ecology-E.J.Koromondy,1996, concept of modern biology series, Prentice Hall.
9. Modern Concepts of Ecology-H.D.Kumar
10. Principles of Environmental Biology-P.K.G.Nair,Himalaya Pub. House, Delhi
11. Ecology by N.S.Subrananayam and A VSS Sambamuthy

12. Basic Ecology – E.P. Odum
13. Modern Concepts of Ecology – H.D. Kumar
14. Principles of Environmental Biology – P.K.G. Nair, Himalaya pub. House, Delhi
15. Environmental Biology – P.D. Sharma, Rastogi Publication, Meerut.
16. Ecology and Environment - P.D. Sharma, Rastogi Publication, Meerut
17. Environmental Science – Enger, Smith, Smith, W.M.C. Brown company publishing

B.Sc First Year ; Semester – I;
Subject: Environmental Science
Discipline Specific Course (DSC)
DSC-2: Lab Course-I
(Compulsory Practical Course with 02 credits ; 60 Contact Hours) (Based on DSC-1)

Course Objectives

Students will be able to know

1. Students will be able to know the Laboratory Safety Rules'
2. Students will get an ability to understand different living components of ecosystems.
3. Students will be able to understand non-living components of the environment.

List of Practical's:

1. To study the 'Laboratory Safety Rules'.
2. To study the cleaning methods of glass wears.
3. To study the First-Aid and emergency treatment in laboratory.
4. Collection and Preservation of phytoplankton and zooplankton samples from different
   Water bodies (river, pond, Lake etc)
5. The qualitative study the phytoplankton's (any 10 specimens).
6. The qualitative study the zooplanktons (any 10 specimens).
8. Collection of hydrophytes, xerophytes, mesophytic and halophytic plants / animals Specimens.
9. Study of xeric adaptation in plants, morphometrically and histologically.
10. Study of xeric adaptations in animal (at least 5 specimen's morphometrically)
11. Study of mesophytic specimens (at least 5 specimens).

Course Outcome

After completion of course, students will be able to:

1. understood the ecological adaptions in different ecosystems.

understood river and lake ecosystems in holistic manner

Skill Enhancement Course (SEC)

SEC-1A: Life Cycle Causting of Waste Water Treatment

(Elective Theory Course with 01 credit; 15 Contact Hours)

(Choose any one from SEC1-A and SEC1-B)

Course Objectives

Students will be able to know

1. life cycle analysis sewage treatment plant
2. steps in the sewage treatment analysis
3. Understand the repair and maintenance of STP.

Course Outcome

After completion of course, students will be able to:

1. determine the cost of STP development.
2. determine the cost of maintenance of STP
3. understood the cost of MBR & SBR technology.

Unit-I: - Life cycle costing and cost comparison of STP: 08 hrs

Introduction, Determination of present value of STP, costing sample calculation, cost comparison of STP using different secondary treatment technologies, description of sewage treatment plant, service life of different components, Annual maintenance, repair and consumable cost assumptions, Assessment of future one-time costs, manpower and electricity cost calculations, Estimation of total present worth cost of 1 MLD capacity STP.

Unit-II :- 07 hrs.

case studies of different secondary treatment technologies for STP; Estimation of Life Cycle Costing for MBR, EA-ASP and SBR technologies as secondary treatment.

Books Recommended:

1. IS 13174 1991. Life cycle costing, part-1: Terminology. Bureau of Indian Standards, New Delhi, India.
2. IS 13174 1991. Life cycle costing, part-2: Methodology. Bureau of Indian Standards, New Delhi, India.
3. CPHEEO (2012). Manual on sewerage and sewage treatment, part A : Engineering final draft, central public health and environmental engineering organization. Ministry of Urban Development, New Delhi.
4. Environment Agency. Guidance waste water treatment works : Treatment monitoring and compliance limit (www.gov.uk)

Skill Enhancement Course (SEC)

SEC-1B: E -Waste Management

(Elective Theory Course with 01 credit; 15 Contact Hours)

Course Objectives

Students will be able to know

- To understand scenario of E-waste
- Discuss key elements of E-waste management
- Understand key terms associated with E- waste Imparting life skills about E waste management in routine daily life to minimize the hazards and to understand the regulations to contribute in effective management throughout the society

Unit-I: - Introduction of e-waste: **08 hrs**

E- Waste at local and global context; Sources of E-waste as pollutants, E waste hazardous properties, domestic e-waste disposal, occupational and environmental health perspectives of e-waste; Effects of pollutant (E- waste) on living organisms health and surrounding environment, Need of human health safeguards and environmental protection from e-waste; Present scenario of E-waste generation in India,

Unit II: - E waste management: **07 hrs**

Basic principles of E waste management; Component of E waste management; E-waste management techniques; Resource recovery potential of e-waste; Technologies for recovery of resources from electronic waste; Mechanical and chemical processes; Steps in recycling and recovery of materials

E- waste management in India: Land filling, Incineration, Recycling, E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016; Role of citizens in E-waste mitigation.

Course Outcome

After completion of course, students will be able to:

. .• Learn about the various aspects of E-waste

• Understand the role of various stakeholders-producers, manufactures etc

Books Recommended:

(1) 1. Johri R., "E-waste: implications, regulations, and management in India and current global best practices", TERI Press, New Delhi.

(2) Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009

(3) Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier

(4) Dr. Ishwar B. Ghorude, Dr. Sham H Mankar, Prof. Jyothi M.R. & Dr. Pranjit

Kumar Bhuyan: Solid waste Management problems and solutions. First Edition.
A. G.Publishing House, Bhopal, M. P. India.

Skill Enhancement Course (SEC)

SEC-2 A: Lab Course -II

(Elective Practical Course with 01 credit ; 30 contact hours) (Based on SEC-1A)

Course Objectives

Students will be able to know

1. the source of sewage generated in urban or suburban areas.
2. the quality of sewage generated in urban area in terms of its physico-chemical parameters.

3.working principle of equipment's used in sewage analysis.

Course Outcome

After completion of course, students will be able to:

1. quality of sewage needed for giving proper treatment
2. understood the working of sewage treatment plant
3. understood the working of PSF and ACF installed in STP.

List of Practical's:

1. Visit to municipal corporation area to see generation of sewage.
2. To study the sewage collection system in urban area / semi urban area..
3. Determination of physical parameters of sewage: i) pH, ii) colour of sewage sample.
4. Determination of electric conductivity of sewage
5. Determination of nitrate content from sewage sample.
6. Determination of phosphate content from sewage sample.
7. To study the flow chart of Sewage Treatment Plant (STP)
8. To study the principle and working of Pressure Sand Filter used in STP.
9. To study the principle and working of Activated Carbon Filter used in STP.
10. Determination of oil and grease from sewage sample.
11. Determination of BOD of sewage sample
12. Determination of residual chlorine from treated water.

Skill Enhancement Course (SEC)

SEC- 2 B: Lab Course -II

(Elective Practical Course with 01 credit ; 30 contact hours) (Based on SEC-1B)

(Choose any one from pool of courses)

Course Objectives

Students will be able to know

- To understand scenario of E-waste
- Discuss key elements of E-waste management

.Course Outcom

After completion of course, students will be able to:

- Learn about the various aspects of E-waste
- Understand the role of various stakeholders-producers, manufactures etc.

List of Practical's:

1. To identify and classify the E-waste as per Government of India norms and list them.
2. To know the source of E-waste and study of e-waste collection system.
3. Listing of toxic materials in e-waste [Waste Electric & Electronic Equipment's (WEEE)]
4. Identification and listing of recyclable materials from e-waste.
5. I dentification and listing of non-recyclable materials from e-waste.
6. An overview e-waste processes and listing of steps involved init.
7. Guidance procedure steps in e-waste / WEEE management in city area. (07 steps)
8. Study of awareness among people about hazardous of e-waste by questioner method.
9. To study the legal provisions about e-waste (handling & disposal).
10. To study the pollution control boards (state & central) rules handling, storage & recycling of e-waste.
11. To determine the percentage of disposed e-waste in disposed municipal solid waste.
12. Survey of WEEE/ e-waste from city area / educational institutes and listing them.

This course will be available for for other faculty students

Generic Electives (GE) /Open Elective (OE)
GE / OE-1: Ecology & Ecosystem Management
(Elective Theory Course- with 02 credits: 30 Contact Hours)

Course Objectives

Students will be able to know

1. detail of ecosystem structure.
2. the management of terrestrial ecosystem management.
3. the management of aquatic ecosystem

Course Outcome

After completion of course, students will be able to:

.1. understood the normal ecosystem.

2.understood the role of ecosystem management for sustenance of environment.

3. significance of ecosystem management for balanced ecosystem.

UNIT- I: Introduction: **10 hrs**

i) Ecology- Definition, Branches, Aut ecology and Syn ecology.

ii) Ecosystem- Concept and structure of ecosystem, Energy in ecological system, Concept of productivity, Energy flow in ecosystem, Food chain, Food web,

Ecological pyramids, Biotic components of ecosystem (producer, consumer and decomposer), Abiotic components of ecosystem.

Unit-II: Types of Ecosystems: **10 hrs.**

1) Terrestrial ecosystem: Desert ecosystem, Grassland ecosystem, Forest ecosystem (Evergreen, Deciduous), Wetland ecosystem.
2) Aquatic ecosystem:
   i) Fresh water ecosystem: a) Lentic ecosystem: Lakes and Ponds
      b) Lotic ecosystem: Rivers and Stream
   ii)Marine ecosystem: Ocean ecosystem, Mangrove ecosystem, Estuarian ecosystem, Marshes ecosystem.

Unit- III: Management of Ecosystem: **10 hrs**

i) Principles of Ecosystem Management,

ii) Principle of Restoration of Degraded Ecosystems:
   a) Concept, Importance
   b) Initiatives taken at National and International level i.e.:
      - National Afforestation Programme,
      - Desert Development Programme,

- Namami Ganga Programme,
- National Wetland Conservation Programme,
- Integrated Marine and Costal Area Management (IMCAM),
- World Lake Vision (WLC),
- *Sarovar Samvardhini (*society for conservation of Lakes).

Books Recommended:

1. **1.** Environment by Shankar IAS Academy Book Publication (2018), Tamil Nadu.
2. ~~World Lake Vision by International Lake Environment Committee (ILEC)~~ Foundation (2007), Japan
3. Principles of Ecology – P.S., Verma and V.K. Agarwal
4. Conservation of Lakes – M. S. Kodarkar, Indian Association of Aquatic Biologists Publication, 2008.
5. Fundamentals of Ecology – Odum E.P.
6. Ecology and Environment – P.D. Sharma
7. Elements of Ecology – P.D. Sharma
8. Ecology – M.P. Arora
9. Basic Ecology – E.P. Odum
10. 10 Concept of Ecology – E.J. Koromondy

Semester - II

Subject: Environmental Science

~~Discipline Specific Course (DSC)~~

DSC-3: Pollutional Aspects of Environment

(Compulsory Theory Course with 02 credits: 30 contact hours)

Course Objectives

- To gain knowledge on environment and its composition
- To understand the type and sources of pollution
- To acquire knowledge on pollution control measures
- To know various polices intended for pollution prevention and control.

~~Course Outcome~~

On completion of the course, students should be able to

1: Gain knowledge on components of environment and its importance

2: Acquired the details about source, types and impacts of pollution

3: Know the sampling and analysis of the pollutants of ambient environment

4: Understand the various air pollution control measures

5: Aware of various polices related to pollution prevention and control

Unit-I: - Introduction to Environment - Environmental factors **10hrs**

Segments of Environment - Man- Environment relationship, anthropogenic effects on the natural environment, Environmental degradation.

Environmental pollution – Definition, causes of environmental pollution – population, urbanization, industrialization, resource consumption, deforestation, agriculture and transportation.

Unit II: - Soil and its pollution

10. hrs

Introduction, Types of Soil, Structure of Soil horizon, process of soil formation, Importance of organic fertilizers, Soil microbiology, Standards or soil quality required for various crops, Types of Soil Pollution, Soil pollution cause, effects and remedies, Conservation of soil, Soil erosion. Effects of chemical fertilizers, pesticides on soil quality.

Unit-III: Water Pollution **10 hrs**

Introduction- Definition, significance of pollution studies. Sources of water pollution- domestic, industrial, & agricultural; point source and non-point sources of water pollution

Types of water pollution- surface water and underground water pollution;

Impact of water pollution on human, plants and animals

Books Recommended:

1.Environmental Science by S.C. Santra, New Central Book Agency, New Dehli
2.A textbook of Environmental Studies by D.K. Astana S. Chand and Company New Delhi
3.A textbook of Environmental Science by R.N Trivedi, Anmol Publication Pvt Ltd.
4.Soil Pollution and Soil Organism-P.C.Mishra, Ashish Pub. Home
5.Soil Conservation-Norman Hudson, IInd Ed, and English language book Soc.
6. Soil and Water Conservation-Resurges, Standard Pub.And distributor.
7. Waste and waste water engineering by R.C Rangwala
8. Waste and waste water engineering (Vol. II) by Fair/Geyer/Ocun
9. B.K Sharma – Environmental chemistry –Goel publication.
10. A.K. De - Environmental Chemistry
11. Tyagi and Mehra - Environmental Chemistry
12. Trivedi P.R & Raj Gurdeo - Environmental water and soil Analysis, Akasdeep Pub. House, New Delhi.
13. V.K.Alhuwalia, Environmental Chemistry Ahe books, India
14. S.P. Misra and S.N. Pandey – Essential Environmental studies- Ane books Pvt. Ltd.
15. Abbasi.S.A. 1998. Environmental pollution and its control. Cogent International, Pondichery.
16. Gosh. Environmental Pollution
17. Rajvaidya. Environmental pollution control.
18. Agarwal. Water pollution
19. Khopkar. Environmental Pollution.
20. Daneil.A.Vallero. Environmental contamination Assessment and control
21. A.K.tripathi, S.N.Pandey, Water Pollution

Discipline Specific Course (DSC)

DSC-4: Lab Course-III

(Compulsory Practical Course with 02 credits ; 60 Contact Hours) (Based on DSC-3)

Course Objectives

Students will be able to know

1. principles of polluted water analysis
2. understood the quality parameters of polluted water

Course Outcome

After completion of course, students will be able to:

1. To analyse the polluted water samples quality parameters.
2. learn the monitoring of water quality parameters of polluted water sample.

List of Practical's:

1. Determination of turbidity of polluted water sample.
2. Determination of dissolved oxygen content from polluted water by alkali azide method or by modified Winklers methode.
3. Determination of sodium content from polluted water sample by flame photometer.
4. Determination of potassium content from polluted water sample by flame photometer.
5. Determination of permanent hardness from polluted water sample.
6. Determination of sulphate from polluted water/waste water sample.
7. Determination of total nitrogen content Kjeldhal method from polluted water sample.
8. Determination of total phosphorous content from polluted water sample.
9. Estimation of H2S from polluted water
10. Chemical oxygen demand COD of polluted water sample.
11. Estimation of Nitrate content from polluted water.
12. Field visit to study the polluted water resource and identification of cause of pollution

Vocational Skill Course (VSC)

VSC-1A: Sustainable & Millennium Developmental Goals

(Elective Theory Course with 01 credit : 15 Contact Hours)

(Choose any one from VSC-1A and VSC-1B)

Course Objectives

Students will be able to know

1. Know the history of the SD idea
2. Be able to discuss the conflicts which are involved in the SD concept on the national as well as on the global scale.
3. Be familiar with potential strategic options for SD (efficiency, sufficiency).
4. Be able to discuss the (dis-)advantages of instruments for SD.
5. Understand the SD challenge for companies, their responsibility and their potentials for action

Course Outcome

After completion of course, students will be able to:

1. Define Sustainable development Goals.
2. Explain Sustainable and millennium development.
1. Apply the knowledge of Industry, Innovation for sustainable development.

Unit-I: - Sustainable Development Goals: **08hrs**

Good Health and Well-being, Quality Education, Affordable and Clean Energy, Decent Work and Economic Growth, Reduced Inequalities, : Peace, Justice and Strong Institutions, No Poverty, Zero Hunger, Clean Water and Sanitation, Industry, Innovation and Infrastructure, Gender Inequality, Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.

Reduce inequality within and among countries, Make cities and human settlements inclusive, safe, resilient and sustainable,

Unit II: - Millennium Development Goals: **07**.hrs

Achieve universal primary education, Promote gender equality and empower women, Reduce child mortality, Improve maternal health, Combating HIV/AIDs, malaria, and other diseases, Ensure environmental sustainability, Develop a global partnership for development

Books Recommended:

1. Lessons from the health-related Millennium development goals

2. N. Kanie, F. Biermann (Eds.), Governing Through Goals: Sustainable Development Goals as Governance Innovation, MIT Press (2017), pp. 165-186
3. Inclusive sustainable development: a human rights perspective
4. Curr. Opin. Environ. Sustain., 24 (2017), pp. 58-62

5. Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals
6. Curr. Opin. Environ. Sustain., 26–27 (2017), pp. 26-31

Vocational Skill Course (VSC)

VSC-1B: Municipal Solid Waste Management

(Elective Theory Course with 01 credit : 15 Contact Hours)

Course Objectives

Students will be able to know

1. source and composition of municipal solid waste.
2. properties of municipal solid waste.
3. proper solid waste collection methods.

Course Outcome

After completion of course, students will be able to:

.1. learn about systematic solid waste disposal methods

2.learn about energy recovery potential of municipal solid waste.

3. understand the recycle potential of municipal solid waste.

Unit-I: -Sources and Composition of Municipal Solid Waste: **08hrs**

Introduction, Sources of solid waste, Types of solid waste, Composition of solid waste and its determination. Physical properties of Municipal Solid Waste, Chemical properties of Municipal Solid Waste, Biological properties of Municipal Solid Waste, Transformation of Municipal Solid Waste

Unit II: - **07hrs.**

Solid Waste Generation and Collection Methods for Municipal Solid Waste, , Solid waste generation and collection, Processing and disposal of Solid Waste Processing of solid waste at residence e.g. Storage, conveying, compacting, Shredding, pulping, granulating etc., Processing of solid waste at Commercial and industrial site, Combustion and energy recovery of municipal solid waste, landfill processes

Books Recommended:

1. 1. Wealth from Waste-S.C.Bhatia (Vol.II), Atlautic Pub
2. Municipal Solid Waste management by Bandela N.N. and Tare
3. Essential Environmental Studies by S.P.Misra, S.N.Pandey
4. Environmental chemistry and pollution control by S.S.DADR
5. Environmental Chemistry-B.K.Sharma
6. Environmental Science –S.C.Santra, New central book agency.
7. A text book of Environmental studies-D.K.Asthana and Meera Asthava
8. George Tchobanoglouset.al., "Integrated Solid Waste Management", McGraw- Hill Publishers, 1993. 177
9. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994.

10. Municipal Solid Waste Management – N. N. Bandela, D.G.Tare,B.R.PublishingCorporation,2009
11. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
12. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes –problems and Solutions", Lewis Publishers, 1997.
13. Bhide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 1993.

Vocational Skill Course (VSC)

VSC-2 A: Lab Course -IV

(Elective Practical Course with 01 credit : 30 Contact Hours) (Based on VSC-1A)

Course Objectives

Students will be able to know

1. understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
2. the goals and activities of sustainable development
3. **Course Outcome**
4. After completion of course, students will be able to:
5. .1. prepare the worksheet for no poverty and zero hunger.
6. **2.**basic data collection for the assessment of sustainable development of people.

List of Practical's:

1. Enlist the 17 global goals for the sustainable development.
2. Enlist the targets for all global goals of sustainable development.
3. Enlist the main activities to achieve the global goals of sustainable development.
4. Survey of urban / rural population for prediction of health status of community (by survey method)
5. Survey of urban / rural population for employment as basic aspect of sustainable development.
6. Preparation of worksheet for No Poverty, Zero Hunger, Life & Land.
7. Survey of urban / rural population for hungry population by survey method.
8. Survey of nutritious food available urban / rural areas for living population.
9. Determination of nutritional value of food: i) total sugars in fruits, ii) total protein
   in pulses, iii) total oil content in oil seed,
10. Qualitative detection of minerals and vitamins in fruits.
11. Survey of vegetables, fruits & food grains in markets for availability.
12. Study of food consumption pattern in society by questioner method.

Vocational Skill Course (VSC)

VSC-2B: Lab Course -IV

(Elective Practical Course with 01 credit : 30 Contact Hours) (Based on VSC-1B)

Course Objectives

Students will be able to know

1. Learn Solid waste sampling by quartering and coning method and determination of Organic Carbon & Percent Organic matter.
2. Acquire knowledge of composition, density, moisture content, volatile and non-volatile matter, and calorific value of Municipal Solid Waste (MSW)
3. Study normal compost and vermi-compost with respect to physic-chemical parameters nitrogen and phosphate)
4. Study of micronutrients from the soil and Land use pattern of the region.

Course outcome

After completion of course, students will be able to:

1. Carry-out Solid waste sampling by quartering and coning method and determine of Total Organic Carbon & Percent Organic matter in the given soil sample
2. Estimate composition, density, moisture content, volatile and non-volatile matter, calorific value of Municipal Solid Waste (MSW)
3. Determine normal compost with respect to physic-chemical parameters nitrogen and phosphate.
4. To know the micronutrients from soil and Land use pattern of the region.

List of Practical's:

Determination of electrical conductivity of compost prepared from solid waste sample.
2. Determination of physical composition and characteristics of municipal solid waste.
3. To study the Solid waste sampling by quartering and coning method.
4. Determination of percent composition of Municipal Solid Waste (MSW) from the given mixed MSW.
5. Determination of density of solid waste sample.
6. Determination of moisture content of solid waste sample by Gravimetric method.
7. Determination of volatile matter in an MSW.
8. Determination of non-volatile matter in an MSW
9. Determination of potassium content from the organic manure prepared from MSW..
10. Analysis of compost prepared from MSW for total nitrogen.
11. Analysis of compost prepared from MSW for total phosphorus.
12. Determination of Total Carbon from compost prepared from MSW.

This course will be available for the students from other faculty

Generic Elective (GE) /Open Elective (OE)
GE / OE-2: Microbial Aspects of Environment
(Elective Theory Course-1 with 02 credits : 30 Contact Hours)

Course Objectives

Students will be able to know

1. Students will learn the major principles of environmental microbiology and the relationship of microbes to environmental processes and other living organisms.
2. Students will demonstrate proper scientific procedure to identify various type of environmental microbes.
3. Students will be able to explain the scientific basis for each technique used.

Course Outcome

After completion of course, students will be able to:

1. The students understood the relationship of microbes to environmental processes and other living organisms.
2. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
3. The students acquires skill to use microorganisms for mitigation of environmental problems

Unit-I: - Introduction: - **10hrs**

Definition, Scope, Importance, History of Microbiology, Structure and classification of microbes, Prokaryotic cell, Eukaryotes

Basic methods in microbiology: microscopic methods, Techniques of sterilization, Media preparation, Isolation and inoculation, direct observation and staining techniques, Maintenance and preservation of cultures

Unit II: - Micro-organism **10hrs.**

Bacteria: Morphology and general characters, classification bacteria based on shapes, pH, Temperature, Oxygen, Growth of bacteria.

Viruses: Morphology, General characters of viruses,

Distribution (Animal, Plant and Bactriophage viruses), classification of virus based on morphology and chemical composition and mode of replication

Unit-III: Microorganisms and Human diseases **10hrs**

Microorganisms and Human diseases: Diseases caused by

Bacteria: Cholera, Typhoid, Tuberculosis, , Diarrhoea

Viruses: COVID-19, Polio,

Protozoa: Malaria, Amoebiosis, sleeping sickness

Microorganisms in Environment as pollution

Books Recommended:

1. Microbiology by Pelczar and Ried
2. Environmental Microbiology by Ralph Mitchell
3. Wastewater Engineering- Treatment and Reuse, Metcalf and Eddy, Inc., Revised by
   Tchobanoglous, Burton and Stensel
4. Introduction to Microbiology by A.S. Rao
5. Environmental Microbiology by Manish L. Shrivastva
6. Handbook of Bioremediation Edited by Norris et al, Robert S. Kerr; Environmental Research Laboratory.
7. Bioremediation Principles: Ewies, Ergas, Chang and Schroeder
8. Human Diseases by Neighbor Marianne
9. Common Human Diseases by M. K. Raman
10. Madigan, M., J. Martinko, and J. Parker. *Brock Biology of Microorganisms*. 10th ed. New York: Prentice Hall, 2002. ISBN: 0130662712.
11. Environmental Microbiology, 3rd Edition, (Pepper, Gerba, Gentry), Academic Press.
    Philadelphia, Pennsylvania, ISBN: 978-0123946263
12. Brock Biology of Microorganisms, 13th Edition, (Madigan,Martinko, Stahl, Clark), Benjamin Cummings Publishers, Upper Saddle River, New Jersey, ISBN: 978- 0321649638.

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