



SIES (Nerul) College of Arts, Science and Commerce (Autonomous)
Syllabus for Approval

B.Sc (Environmental Science)

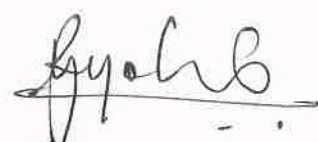
Sr. No.	Heading	Particulars
1	Title of the course	B.Sc (Environmental Science)
2	Eligibility for admission	HSC with PCB or PCM or Equivalent
4	Semester	V
5	Level	UG
6	Pattern	3-4 years & 6-8 semesters Choice Based Grading System
7	To be implemented from	From Academic year 2025-26 in a Progressive manner

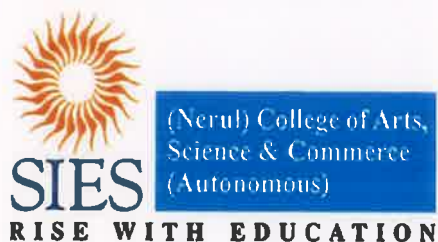
Date: February 22, 2025

Signature:


Dr. Koel Roychoudhury
AC Chairperson




Dr. Jyoti G. Koliyar (Jatinder Das)
Head of the Department



SIES (Nerul) College of Arts, Science and Commerce (Autonomous)
(Affiliated to University of Mumbai)
RE-ACCREDITED GRADE "A" BY NAAC (3rd CYCLE)

**BOARD OF
STUDIES**

**SYLLABUS
FOR
B.Sc in Environmental Science
(AC. Item No.2.3)**

(WITH EFFECT FROM THE ACADEMIC YEAR 2025-2026)

PROGRAMME OBJECTIVES:

1. To exploit opportunities in the Environmental Sciences.
2. To create better avenues for improving employability.
3. To provide exposure to new environmental sciences field
4. To enable increased industry academia interaction

PROGRAMME OUTCOMES:

1. At the end of the programme, students are able to expand through understanding in key areas in the subjects presented.
2. At the end of the programme student get trained to cater to the need for ecological citizenship through developing strong foundation on critical linkage between ecology-society-economy. .
3. At the end of the programme, learner will become aware of the importance of working with safety and consciousness in laboratory and actively pursue information about health and environmental safety of chemicals used.
4. At the end of the programme, learner will recognize the need of constant expertized improvement through lifelong learning.



SIES Nerul College of Arts, Science and Commerce (Autonomous)
B.Sc. Environmental Science Programme

(To be implemented from Academic Year- 2025-26)

No. of Courses	Course Code	Semester V	Credits
1	Major		
1	U25ES5MJ01	Climate Change	03
	U25ES5MJP01	Practical's in Climate Change	01
2	U25ES5MJ02	Natural Resources and Sustainability	03
	U25ES2MJP02	Practical's in Natural Resources and Sustainability	01
2	Minor		
	U25ES5MI01	Introduction to Sustainable Development	04
3	Major Electives		
1	U25ES5E01	Natural Disaster Management	04
5	AEC/VEC/IKS		
1	U25ES5IKS01	Organic Farming	2
6	OJT,FP,RP,CEP,CC		
	U25CC5CEP01	CEP	4
Total Credits			22



Climate Change

COURSECODE: U25E55MJ01

COURSE CREDIT: 04 (03theory+01practical)

1credit – 15 lectures

1 lecture is 60minutes

Course Objectives:

CO1: Understand the Fundamentals of Climate Change.

CO2: Examine the Impacts of Climate Change Adaptation and Mitigation Strategies:

CO3: Study National and International Policies and Frameworks and promote sustainable development.

Course Outcome:

CO1: Understand the Basics of Climate Change and assess the Impacts of Climate Change.

CO2: To assess the Impacts of Climate Change and also to apply Climate Change Adaptation and Mitigation Strategies.

CO3: To Evaluate International and National Policy Frameworks.

Sr.No	Syllabus	No. of lectures
01	Module I- Climate Change <ul style="list-style-type: none">• Introduction to climate change• Earth's Climate System Today: Earths Energy Budget,• The concept of Radiative Forcing• Greenhouse effect, Greenhouse effect potential and associated concerns of greenhouse gases in climate change • Global warming, El Nino • LaNina, Factors responsible for climate change • Climate change in relation to the changes in patterns of temperature, precipitation and sea level rise	15
02	Module II- Impacts of Climate Change <ul style="list-style-type: none">• Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; atmospheric windows; impact of climate change on atmosphere, weather patterns, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.• Melting of glaciers, Sea level rise, Ocean acidification, Loss of biodiversity, Agriculture, Forestry, Impacts of Climate Change in different parts of India with future predictions.• REDD, REDD+	15



03	<p>Module III: Climate Change adaptation, mitigation and resilience</p> <ul style="list-style-type: none"> • Climatic Systems and Challenges Global Climate System • Internal Variability and External Climate Forces • Evidence and Measurement of Climate changes • Adaptation to climate change • Climate change mitigation • Climate Justice- case studies • Resilience- technologies and case studies <p>The Economics of Carbon Mitigation: Integrated Assessment Models (IAM) Regional, National and International Experiences</p> <p>Module III- Climate change: International and National policies and frameworks</p> <ul style="list-style-type: none"> • Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism. • Earth Summit • COP- Loss and damage for climate change • Blue carbon initiative • NCAP • NAFCC • NDCs • NAPCC-Panchamrit • Mission Green and Life • Paris Agreement Mitigation Approaches in Climate Change Climate Change Modeling • Carbon Emissions Reduction Technologies • Governance for Climate Change • Technology Options Fuel Switching and Carbon Sequestration • Adaptation Strategy/ Mitigation Measures 	15
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References:

1. Global Climate Change. (2021). Srivastava, K. K. Netherlands: Elsevier Science.
2. Assessment of Climate Change Over the Indian Region: A Report of the Ministry of Earth Sciences (MoES), Government of India. (2020). Germany: Springer Open.
3. Romm, J. J. (2018). Climate Change: What Everyone Needs to Know. United States: Oxford University Press.
4. Hall, N. (2016). Displacement, Development, and Climate Change: International Organizations Moving Beyond Their Mandates. United Kingdom: Taylor & Francis.
5. Fletcher, C. H., Fletcher, C. (2018). Climate Change: What The Science Tells Us. United Kingdom: Wiley.
6. Loss and Damage from Climate Change: Concepts, Methods and Policy Options. (2018). Germany: Springer International Publishing.
7. Hulme, M. (2021). Climate Change. United Kingdom: Taylor & Francis.
8. IPCC
9. UNEP



Practicals

COURSECODE	TITLE	CREDITS	HOURS
U25ES5MJP01	Climate Change	1	30
1. Estimation of carbon sequestration by using different methods 2. Impacts of extreme events in selected areas: A case study 3. Preparation of documentary on climate change and sustainability practices of an organization or agency or village area 4. Studies on measurements of sustainable farming practices 5. Questionnaire survey on climate change/sustainability based on online platforms and analysis 6. Measurement of carbon footprint and ecological footprints by using online software			

References:

1. Global Climate Change. (2021). Srivastava, K. K. Netherlands: Elsevier Science.
2. Assessment of Climate Change Over the Indian Region: A Report of the Ministry of Earth Sciences (MoES), Government of India. (2020). Germany: Springer Open.
3. Romm, J. J. (2018). Climate Change: What Everyone Needs to Know. United States: Oxford University Press.
4. Hall, N. (2016). Displacement, Development, and Climate Change: International Organizations Moving Beyond Their Mandates. United Kingdom: Taylor & Francis.
5. Fletcher, C. H., Fletcher, C. (2018). Climate Change: What The Science Tells Us. United Kingdom: Wiley.
6. Loss and Damage from Climate Change: Concepts, Methods and Policy Options. (2018). Germany: Springer International Publishing.
7. Hulme, M. (2021). Climate Change. United Kingdom: Taylor & Francis. What Is Climate Change? (What Was?) by Gail Herman (Author), Illustrated by John Hinderliter, Penguin Workshop (2018).
8. Climate Change Biodiversity and Green Economy by H.S. Sharma S. Padmaja and Ganesh Sharma, Concept Publishing Company Pvt. Ltd. (2013).
9. Climate Change by Joseph Romm OUP US (2018).
10. Environment and Sustainable Development by M.H. Fulekar, Bhawana Pathak, R K Kale, Springer Nature (2013).
11. Sustainable Development in Digital Era by Dr. Aparna Mishra, Dr. VikasDahiya, Dr. KaminiTandon, JSR Publishing House LLP; (2019).
12. The Age of Sustainable Development by Jeffrey D. Sachs and Ban Ki-moon, Columbia University Press (2015).
13. Target 3 Billion: Innovative Solutions Towards Sustainable Development by APJ Abdul Kalam, Srijan Pal Singh, Penguin India (2011).
14. Management of Resources for Sustainable Development by SushmaGoel, The Orient Blackswan



Natural Resources and Sustainability

COURSE CODE: U25ES5MJ02
practical)

COURSE CREDIT: 04 (03 theory+01

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives and Outcomes

CO1: To understand the classification, distribution, and importance of natural resources, along with their role in ecosystem functioning and human dependence.

CO2: To explore various energy resources, their availability, environmental impacts, and the role of renewable energy in sustainable development

CO3: To examine energy conservation strategies, environmental policies, and sustainability initiatives in India.

Course Outcome:

1. Students will be able to analyse resource availability, consumption patterns, and environmental impacts in India.
2. Students will understand the significance of energy resources and evaluate India's renewable energy potential and policies.
3. Students will be able to assess the effectiveness of policies and strategies in promoting sustainable resource management.

Unit 1	Introduction to Natural Resources	15
	Definition and classification (renewable & non-renewable) Importance of natural resources for human survival and development, Natural Capital, Resource distribution and consumption patterns in India Ecosystem Services and Resource Utilization: Role of natural resources in ecosystem functioning Types, inventory, and distribution of Water Resources, Forest Resources, Mineral resources, land, and soil resources. Problems associated with natural resources their causes and impacts on the environment	
Unit II	Renewable and Non-Renewable Energy Resources	15
	Introduction to Energy Resources, Definition and classification of energy resources, Role of energy in economic and social development Non-Renewable Energy Resources: Fossil fuels: Coal, petroleum, and natural gas (availability and usage in India), Environmental impacts of fossil fuel extraction and consumption. Nuclear energy: Sources, benefits, and concerns. Renewable Energy Resources: Solar energy: Wind energy: Hydropower, Biomass, and geothermal energy: Scope and limitations	
Unit III	Energy Conservation and Policies for Sustainability	15



	Energy efficiency measures in industries, transport, and households, Policies promoting clean energy (e.g., National Solar Mission, Renewable Energy Act), and prospects of a carbon-free economy in India. Environment Protection Act (1986), Forest Conservation Act (1980), National Biodiversity Act (2002), National Water Policy (2012), Smart Cities Mission, National Electric Mobility Mission, National Agroforestry Policy (2014) □ Soil Health Card Scheme, Innovations for sustainable resource management.	
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Practical (Credit 1) 15

1. To study vegetation studies by line, quadrat and belt transect methods.
2. Calculation of Biodiversity Index of specified area
3. Field Visit to Aquatic/Forest and other ecosystems for identification of biota and submit report
4. Construction of Ecological pyramids of different ecosystems.
5. Create inventory of minerals resources and plot it on map of India
6. To carry out Energy Audit/ Water Audit of an area

References

- Environmental Studies by R. Rajagopalan, Member, Governing Board, International Ocean Institute, Malta, Oxford University Press
- Renewable Energy - Environment and Development by Mhaeshwar Dayal, Konark Publication Private Limited
- Non-Conventional Energy Sources by S. N. Kaul, A. R. Bhalerao, R. K. Trivedy, Current Publication
- Fundamentals of Ecology by Madhab Chandra Dash, Satya Prakash Jha, Tata McGraw Education Private Limited
- Environmental Policy by Neil Kheti, Oxford Book Company
- Environment and Development by B. N. Pandey and G. K. Kulkarni, A. P. H. Publishing Corporation
- Green Energy Technologies by Utkarsh Sharma, Jnanada Prakashan



Introduction to Sustainable Development

COURSE CODE: U25ES5MI01 **COURSE CREDIT:** 04 (03 theory+01 practical)
1 credit - 15 lectures **1 lecture is 60**

Course Objective

CO1: To understand why sustainable development is needed and how it has evolved.

CO2: To learn about major global efforts and policies for sustainability.

CO3: To understand the three main pillars of sustainability—economic, environmental, and social—and how they work together.

Course Outcome:

1. Students will be able to explain key environmental, social, and economic issues that led to the concept of sustainability.
2. Students will be able to describe important international agreements and their role in promoting sustainability.
3. Students can apply sustainability principles in real-world situations and analyze case studies.

Unit 1	Evolution and Necessity of Sustainable Development	15
	Need: Issues of Resource Depletion, Environmental Degradation, Social Inequality, Economic Stability Global Climate Challenges Social and economic insecurities. Early Concepts of Sustainability- Indigenous practices & ecological wisdom, Industrial Revolution: resource exploitation & pollution, Rise of Global Environmental Awareness, Great Smog of London (1952), Silent Spring (1962), The Triple Bottom Line of Sustainability	
Unit II	Global Initiative toward Sustainable Development	15
	Stockholm Conference, UN Conference on the Human Environment, World Conservation Strategy IUCN, UNEP, WWF Brundtland Report -Our Common, Rio Earth Summit (UNCED) - Agenda 21, Rio Declaration, UNFCCC, and the Convention on Biological Diversity. Millennium Development Goals (MDGs), World Summit on Sustainable Development, 2002, Rio+20 Summit 2015, Sustainable Development Goals (SDGs), Paris Agreement – 2015, COP26 -2021 – Glasgow Climate Summit	
Unit III	Dimensions for Three Pillars of Sustainability	15
	Economic, environmental, and social sustainability—overview, Definition, principles, and challenges Economic Sustainability: Role of green economy and circular economy, case studies of sustainable financial models, Concept, and role of ESG and CSR, Role of SDG 2030. Environmental Sustainability: Ecosystem services and natural resource management for water, energy, waste, and biodiversity Conservation and Ecosystem Protection: Importance of biodiversity in sustainability, Strategies for habitat conservation and restoration: Social Sustainability: Equity, inclusion, and human rights, Role of education, healthcare, and cultural heritage, Sustainable	



	Communities, sustainable cities (Smart Cities, SDG 11), Role of NGOs and global partnerships, Interconnections of the Three Pillars with Case studies of integrated sustainability approaches	
	Practical sustainable developments (Credit 1)	15
	1. Assess the sustainability practices on campus identify areas for improvement and write detail report 2. Calculate Carbon Footprint to evaluate personal and institutional contributions to greenhouse gas emissions. 3. Field visit/ or understand sustainable farming practices and their Sustainable development strategies. 4. Understand and write sustainability report of any industry	

References

1. **Sharma, P. D. (2021).** *Ecology and Environment*. Rastogi Publications.
2. **Gupta, K. R. & Prasad, A. (2022).** *Sustainable Development: Issues and Challenges*. Atlantic Publishers.
3. **Dresner, S. (2008).** *Principles of Sustainability*. Routledge.
4. **Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2012).** *What is Sustainable Development? Goals, Indicators, Values, and Practice*. Environment: Science and Policy for Sustainable Development.



Natural Disaster Management

COURSECODE: U25ES5E01

COURSE CREDIT: 04 (Theory)

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- CO1: To Understand Earth and Atmospheric Processes
- CO2: To Identify Types of Natural Hazards
- CO3: To study about Droughts and Floods
- CO4: To examine about Cyclones and Landslides

Course Outcomes:

- CO1: Elucidate the factors associated with different types of natural hazards.
- CO2: Understand the causes and potential impacts of various natural hazards.
- CO3: Decipher the vulnerability and risks of different natural hazards in various regions.
- CO4: Empower themselves with management skills associated with various types of disasters in order to Handle any potential risk situation.

Sr.No	Syllabus	No. of lectures
01	Module I- Earth and Atmospheric processes, Natural Hazards and National Disaster Management <ul style="list-style-type: none">• Earth and atmospheric process: basics of plate-tectonic, hydro-geomorphic and atmospheric (energy atmospheric circulation) processes.• Types of Natural Hazards. National Disaster management framework, National response mechanism, Role of Government bodies such as NDMC, IMD.• Natural hazards, risk, vulnerability; Hazards and risk assessment, Biohazard and Bio disaster.	15
02	Module II- Earthquakes, Tsunami, Volcanoes <ul style="list-style-type: none">• Earthquakes - Origin; Seismic waves; Associated hazards, Earthquake prone regions; Damage caused; Responses and Disaster management strategies; Case study.• Tsunami - Origin; Relation to earthquakes; Impacts; Disaster management strategies; Case study.• Volcanoes - Causes; Impacts; Disaster management strategies; Active volcanoes in the world; Case study.	15



03	Module III- Droughts and Floods <ul style="list-style-type: none"> • Drought: Causes and Impacts; Types of droughts (meteorological, hydrological, agricultural and socio economic); Response to hazards-mitigation and adaptation; Drought status in India; Case study. • Floods: Floods as physical processes (river systems, runoff, river activities); Causes and factors of flooding, Impacts of flooding; Response to flood hazards; Global and Indian scenario; Case study. 	15
04	Module IV- Cyclones and Landslides <ul style="list-style-type: none"> • Cyclones: Genesis; Tropical cyclones - formation, frequency and trajectory; Impacts of cyclones; Mitigation and Adaptation; Management strategies; Cyclones in Indian coasts; Case study. References • Landslides: Genesis (slope failure mechanism); Causes of landslides; Prevention and correction methods; Global and Indian scenario; Case study. 	15

References:

1. Encyclopedia of Natural Hazards. (2013). Bobrowsky, P. Germany: Springer Netherlands.
2. Keller, E. A., DeVecchio, D. E. (2016). Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes. United Kingdom: Taylor & Francis.
3. Blaikie, P., Cannon, T., Davis, I., Wisner, B. (2014). At Risk: Natural Hazards, People's Vulnerability and Disasters. United Kingdom: Taylor & Francis.
4. Lukasiewicz, A. (2020) Natural Hazards and Disaster Justice: Challenges for Australia and Its Neighbours. Germany: Springer Nature Singapore.
5. Rivera, F. (2019) Emerging Voices in Natural Hazards Research.. United Kingdom: Elsevier Science.
6. Arora, P. (2013) Disaster Management: Medical Preparedness, Response and Homeland Security. United Kingdom: CABI.



ORGANIC FARMING

COURSE CODE: U25ES5IKS01

COURSE CREDIT: 02(Theory)

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objective:

1. To provide students with a comprehensive understanding of the fundamental concepts, principles, and practices of organic farming.
2. To equip students with knowledge of various organic farming methodologies to promote sustainable agricultural practices.

Learning Outcome:

1. Students will appreciate the critical considerations in organic farming, including benefits, types, soil health, water conservation, biodiversity, and animal welfare.
2. Students will understand crop management techniques, various organic inputs, and their role in enhancing soil fertility, integrated pest management (IPM) strategies.

Sr. No	Syllabus	No. of lectures
01	Module -1- Introduction to Organic Farming Principle <ul style="list-style-type: none">• Introduction to organic farming, aim, objective, concept, principles and need for organic farming.• Comparison between conventional and organic farming practices• Types of Organic farming, Benefits of organic farming• Important considerations in organic farming: Soil Health, Water conservation, Biodiversity and animal welfare• Organic farming Certification in India: National Programme for Organic Production (NPOP) and the India Organic Logo, APEDA	15
02	Module-2 - Methodologies of organic farming <ul style="list-style-type: none">• Crop Management: Crop rotation, Intercropping and companion planting, Organic seed selection and propagation, Managing crop residues and their utilization• Organic Inputs and Production: Composting, Green manure, farmyard manure, Biofertilizers (Symbiotic nitrogen fixation by bacteria and blue-green algae)• Biological Pest Control: Natural enemies and predators of pests, Integrated pest management (IPM) strategies, Use of biopesticides and pheromone traps	15



References:

1. S.R. Reddy (2017) Principles of Organic Farming, Publisher: Kalyani, ISBN: 9327274474
2. Dr. Kaptan Baboo Dr. Vikas Singh Sengar, Dr. Sandeep Kumar Diwakar, Dr. Deo Kumar, Dr. Avinash Kumar Singh (2023) A Text Book of Modern Organic Farming, Publisher: Book Rivers ISBN: 9355157886
3. M.H.Fulekar (2005) Environmental Biotechnology, Publisher: Oxford IBH Publishing cooperation
4. M.H.Fulekar, Environmental Biotechnology - Theory and Applications, CRC Press and Science Publisher, USA
5. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi.



The scheme of examination shall be divided into two parts:

- Internal assessment 40% i.e. 40 marks
- Semester end examination 60% i.e. 60 marks

(A) Internal Assessment 40 marks

Description	Marks
Internal tests of 20 marks each Q.1 Multiple choice Questions/True or False- 10 Marks Q.2. Attempt 2 questions out of 3 questions (5 marks each)-10 Marks	20
One Project and Viva voce/Presentation/Case studies/Assignments	15
Attendance and Class behavior	5
Total	40

B.Sc. ENVIRONMENTAL SCIENCES

Maximum Marks:

Duration: 2hr

Question 1: Unit I

Question 2: Unit II

Question 3: Unit III

Question 4: Unit IV

Question 5: Unit I to Unit IV (Mixed questions)

- Instructions:
- All Questions are compulsory
 - All questions carry equal marks
 - Draw neat and labeled diagrams wherever necessary

Q.1. Answer any two questions from the following (Based on Unit I)

- 06
- 06
- 06

Q.2. Answer any two questions from the following (Based on Unit II)

- 06
- 06
- 06

Q.3. Answer any two questions from the following (Based on Unit III)

- 06
- 06
- 06



Q.4. Answer any four questions from the following (mixed long question unit I,II,III)–
(Major and Minor Paper)

- a. 06
- b. 06
- c. 06

Q.5. Answer any two questions from the following (Short Notes-Mixed Questions)

- a. 03
- b. 03
- c. 03
- d. 03
- e. 03
- f. 03

Passing criteria: Minimum 40% in Internal (16 out of 40) and 40% (24 out of 60) in semester end examination.

PRACTICAL EXAMINATION: Total Marks: 50

- 1. Major Experiment: 25 Marks
- 2. Minor Experiment: 15 Marks

VIVA: 05 Marks

Journal: 05 Marks

- NOTE: 1. Practical examination to be conducted as per the practical Syllabus enlisted.
2. Candidates are required to present certified journal on the day of practical examination.





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Syllabus for Approval

B.Sc (Environmental Science)

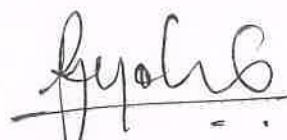
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1	Title of the course	B.Sc (Environmental Science)
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4	Semester	VI
5	Level	UG
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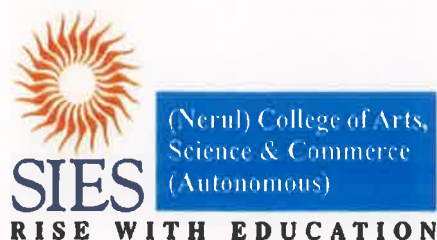
Date: February 22, 2025

Signature:


Dr. Koel Roychoudhury
AC Chairperson




Dr. Jyoti G. Koliyar (Jatinder Das)
Head of the Department



SIES (Nerul) College of Arts, Science and Commerce (Autonomous)
(Affiliated to University of Mumbai)
RE-ACCREDITED GRADE "A" BY NAAC (3rd CYCLE)

**BOARD OF
STUDIES**

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FOR
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(AC. Item No.2.3)**

(WITH EFFECT FROM THE ACADEMIC YEAR 2025-2026)

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1. To exploit opportunities in the Environmental Sciences.
2. To create better avenues for improving employability.
3. To provide exposure to new environmental sciences field
4. To enable increased industry academia interaction

PROGRAMME OUTCOMES:

1. At the end of the programme, students are able to expand through understanding in key areas in the subjects presented.
2. At the end of the programme student get trained to cater to the need for ecological citizenship through developing strong foundation on critical linkage between ecology-society-economy. .
3. At the end of the programme, learner will become aware of the importance of working with safety and consciousness in laboratory and actively pursue information about health and environmental safety of chemicals used.
4. At the end of the programme, learner will recognize the need of constant expertized improvement through lifelong learning.



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B.Sc. Environmental Science Programme

(To be implemented from Academic Year - 2025-26)

No. of Courses	Course Code	Semester VI	Credits
1	Major		
1	U25ES6MJ01	Environmental Management	03
	U25ES6MJP01	Practical's in Environmental Management	01
2	U25ES6MJ02	Environmental Entrepreneurship and Corporate Social Responsibility	03
	U25ES6MJP02	Practical's in Environmental Entrepreneurship Development and corporate social responsibility	01
3	U25ES6MJP03	Environmental Economics	02
2	Minor		
	U25ES6MI01	Restoration Ecology	02
3	Electives(OE)		
2	U25ES6E02	Occupational Health Safety	04
4	AEC/VEC/IKS/VSC		
1	U25ES6VSC01	Geospatial Technology	02
5	OJT,FP,RP,CEP,CC		
	U25ES6OJT01	OJT	04
Total Credits			22



Environmental Management

COURSECODE : U25E56MJ01

COURSECREDIT: 04(03theory+01practical)

1credit-15lectures

1lecture is 60minutes

Course Objectives:

CO1: To introduce students to the fundamental principles of environmental management.

CO2: To provide an understanding of the features, phases, and components of environmental management while exploring its scope and significance.

CO3: To cover the planning and implementation of Environmental Management Systems (EMS) and their linkages with sustainable development.

Course Outcome:

CO1: Gain knowledge on guidelines of the environmental management system.

CO2: Acquire the basic understanding of the audit processes.

CO3: Understand the present scenario of development and environment. CO4: Analyse impact on environment through the cost benefit ratio.

Sr. No	Syllabus	No. of lectures
01	Module I- Introduction to Environment Management <ul style="list-style-type: none">• Concept and definition of Environment Management• Features and phases of environmental management• Components and scope of environmental management• Projecting EMS: planning, implementation, general requirements, control tasks• Development and environmental linkages, Tools of Environmental Management	15
02	Module II- EIA and Environmental Audit <ul style="list-style-type: none">• Definition and concept of EIA• Aims and objectives in EIA• Stages in EIA• Introduction to environmental audit• Features and Objectives of environmental audit• Environmental audit process• Types of environmental audit	15
03	Module III- ISO and LCA in EMS <ul style="list-style-type: none">• Concept of International organization for Standardization• EMS Certification• ISO 14000 series, principles and methodology• ISO 16000, ISO 45000, ISO 50000• LCA - Evolution, cradle to grave approach, procedure, application of LCA, Case study-LCA Concept of Carbon Credits and Eco Innovations <ul style="list-style-type: none">• Kyoto protocol• CDM• Carbon credits and carbon bank• Concept of eco-innovation• Preparation, Strategy, Business model, Implementation and review• Eco-designs• Environmental cost and benefits	15



Practical

COURSECODE	TITLE	CREDITS	HOURS
U25ES6MJP01	Environmental Management	1	30
<ol style="list-style-type: none">1. Questionnaire based survey on utilization of eco-friendly products.2. Study of success stories of eco- designs.3. Study of an EIA procedure for a road project/dam/industry. (case study)4. Study of PDCA cycle of ISO 14000.5. Life cycle analysis of a product of daily use.			

References:

1. Camborne D F, 1997 Environmental Life Cycle Analysis, Lewis Publishers
2. Jadhav H.V. Environmental management, Vipul Prakashan, Mumbai
3. Uberoi N.K. Environmental Management, Excel Book, Delhi
4. Sheldon, C., & Yoxon, M. (2012). Environmental management systems: a step-by-step guide to implementation and maintenance. Routledge
5. Tinsley, S., & Pillai, I. (2012). Environmental management systems: understanding organisational drivers and barriers. Taylor & Francis.
6. Ciambone, D. F. (1997). Environmental life cycle analysis. CRC Press.
7. Klöpffer, W., & Grahl, B. (2014). Life cycle assessment (LCA): a guide to best practice. John Wiley & Sons.
8. Guinée, J. B., & Lindeijer, E. (Eds.). (2002). Handbook on life cycle assessment: operational guide to the ISO standards (Vol. 7). Springer Science & Business Media.
9. Krishna, I. M., Manickam, V. (2017). Environmental Management: Science and Engineering for Industry. India: Elsevier Science.
10. World Resources Institute (1995) "Environmental Indicators: A Systematic Approach to Measuring & Reporting on Environmental Policy Performance in the Context of Sustainable Development", World Resources Institute, Washington, DC.
11. Kalam APJ, Singh, Penguin India (2011). Target 3 Billion: Innovative Solutions Towards Sustainable Development
12. Guinée, J. B., & Lindeijer, E. (Eds.). (2002). Handbook on life cycle assessment: operational guide to the ISO standards (Vol. 7). Springer Science & Business Media.
13. Ciambone, D. F. (1997). Environmental life cycle analysis. CRC Press.
14. Klöpffer, W., & Grahl, B. (2014). Life cycle assessment (LCA): a guide to best practice. John Wiley & Sons.
15. Jackson, S. L. (1997). The ISO 14001 implementation guide: creating an integrated management system (Vol. 3). John Wiley & Sons.



Environmental Entrepreneurship and Corporate Social Responsibility

COURSE CODE: U25ES6MJ02
practical) 1 credit - 15 lectures

**COURSE CREDIT: 04 (03 theory+01
1 lecture is 60 minutes**

Course Objective:

CO 1: To introduce key concepts in environmental entrepreneurship, focusing on eco-friendly products, financing, and green marketing.

CO2: To explore CSR concepts, regulations, and its role in corporate governance and sustainability. CO3: To examine green business opportunities in India, including case studies from various sectors. **Course Outcome:**

1. Students will understand the basics of environmental entrepreneurship and develop strategies for green business opportunities.
2. Students will assess CSR policies and understand their impact on business ethics and sustainability.
3. Students will understand India's green business landscape and develop solutions for environmental entrepreneurship in the country.

Unit 1:	Foundations of Environmental Entrepreneurship	15
	Introduction to Environmental Entrepreneurship – Definitions, scope, and Significance., Eco-Friendly Products and Services – Market trends and opportunities., Financing Green Ventures – Funding sources, green bonds, and venture capital., Green Marketing Strategies – Branding and communication for eco-businesses., Challenges in Environmental Entrepreneurship – Barriers and risk mitigation. Case Study: Successful Green Startups – Learning from real-world examples.	
Unit II:	Corporate Social Responsibility (CSR)	15
	Introduction to CSR – Concepts, evolution, and global perspectives. Environmental Responsibility in Corporations – Case studies of sustainable companies. CSR Regulations and Policies – Indian and global legal frameworks. Corporate Governance and Sustainability – Ethical decision-making and leadership. Green CSR Initiatives – Best practices in corporate sustainability. Global CSR Trends – Innovations and future directions and Social Equity – Inclusion, diversity, and environmental justice. Challenges in CSR Implementation – Barriers and solutions.	
Unit III	Environmental Businesses and Entrepreneurship in India	15
	Green Business Scheme is a program by the National Safai Karamcharis Finance and Development Corporation (NSFDC) Challenges and Opportunities for Green Entrepreneurs in India Case studies from different sectors <ul style="list-style-type: none"> • Organic Farming and Agro-Based Enterprises • Waste Management and Recycling Startups • Eco-Friendly Packaging and Alternatives to Plastic • Renewable Energy-Based Businesses • Handmade and Sustainable Textile Businesses • Sustainable Tourism and Ecotourism Ventures • Water Conservation and Rainwater Harvesting Startups • Urban Farming and Hydroponics • Green Construction and Eco-Housing • Environmental consultancy and laboratory services 	



References:

- 1. "Social Entrepreneurship and Sustainable Business Models: The Case of India" – Anirudh Agrawal & Payal Kumar
- 2. "Sustainable Entrepreneurship: Insights from India" – Dr. Karunakara
- 3. "Corporate Social Responsibility in India: Cases and Developments after the Legal Mandate" – Nayan Mitra & René Schmidpeter
- 4. "Corporate Social Responsibility: Concepts and Cases – The Indian Experience" – C. S. G. Krishnamacharyulu & Lalitha Ramakrishna
- 5. Corporate Social Responsibility: A Study of CSR Practices in India" – V. S. Nandakumar



Practical

1. Propose a project for environmental products and services with actual implementation
2. Visit and survey any entrepreneur through questionnaire method and report preparation.
3. Prepare a report on NABL Accreditation process.

References:

1. "Social Entrepreneurship and Sustainable Business Models: The Case of India" – Anirudh Agrawal & Payal Kumar
2. "Sustainable Entrepreneurship: Insights from India" – Dr. Karunakara
3. "Corporate Social Responsibility in India: Cases and Developments after the Legal Mandate" – Nayan Mitra & René Schmidpeter
4. "Corporate Social Responsibility: Concepts and Cases – The Indian Experience" – C. S. G. Krishnamacharyulu & Lalitha Ramakrishna
5. Corporate Social Responsibility: A Study of CSR Practices in India" – V. S. Nandakumar



Environmental Economics

COURSE CODE : U25ES6MJ03

COURSE CREDIT: 02

1 credit - 15 lectures

1 lecture is 60 minutes

Course

Objective:

- To introduce key concepts of environmental economics. Explain the link between economic activities and the environment.
- To explain methods for valuing environmental goods. Provide knowledge on policy tools for sustainable management.

Learning

Outcome:

- Students will understand market failures and externalities. They will analyze economic theories that address environmental issues.
- Students will apply valuation techniques. They will assess environmental policies and examine climate negotiations.

Sr. No	Syllabus	No. of lectures
01	<p>Module 1-Introduction to Environmental Economics:</p> <ul style="list-style-type: none">• Definition and scope of environmental economics.• The relationship between the economy and the environment.• Concepts of externalities and public goods.• Concept of Consumerism; Poverty and globalization; Neoclassical Economic Paradigm –Environmental Goods and Services; free goods and economic goods; Environmental quality as a public good; Negative externalities and market failure. Economic• Theories Related to Environmental Issues:• Market failures and the environment.• Property rights and environmental problems.• The Tragedy of the Commons and collective action.• Theory of externalities and public good.	15



02	<p>Module 2</p> <p>Valuation of Environmental Goods and Services:</p> <ul style="list-style-type: none"> • Methods of environmental valuation: contingent valuation, hedonic pricing, and travel cost method. Theory of externalities and public good. • Cost-benefit analysis in environmental decision-making. <p>Environmental Policy Instruments:</p> <ul style="list-style-type: none"> • Command-and-control regulations vs. market-based instruments. • Taxes, subsidies, and tradable permits. • Case studies on policy applications. • EPR • Social Impact Assessment • International negotiations on climate change and North South debate; Environment Kuznet Curve (EKC). 	15
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References:

1. Callon, S.J. and Thomas, J.M. 2000. *Environmental Economics and Management Theory, Policy and Applications*. Dryden Press.
2. Subhashini, M. 2010. *Economics of Environment*. PHI Learning Pvt. Ltd.
3. Karpagam, M. (1986). *Environmental Economics*.
4. Murty, S. (1998). *Economic Growth and Environment*. RSBA Publishers.
5. Hanley, N., Shogren, J. F., & White, B. (2007). *Environmental Economics in Theory and Practice*. Palgrave Macmillan.
6. Tietenberg, T., & Lewis, L. (2018). *Environmental and Natural Resource Economics*. Routledge.



RESTORATION ECOLOGY

COURSE CODE : U25ES6MI01

COURSE CREDIT: 02

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objective:

- To provide students with a comprehensive understanding of ecological restoration's foundational principles and significance, emphasizing its necessity, approaches, and the integration of indigenous knowledge in the restoration process.
- Understand and apply ecological principles and methodologies to assess, plan, and implement effective restoration projects that enhance ecological integrity and resilience.

Learning Outcome:

- Students will be able to understand concepts, needs, roles, and principles of ecological restoration along with its holistic approach and Human well-being.
- Students will develop and execute restoration strategies that promote soil and water health, reintroduce native species, create and enhance habitats, and adaptively manage restored ecosystems based on continuous monitoring and feedback.

Sr. No	Syllabus	No. of lectures
01	Module 1- Introduction to Restoration Ecology <ul style="list-style-type: none">• Definition, Principles, and Significances of Ecological restoration.• Necessity of eco-restoration, role of ecological principles in restoration, holistic approach in restoration• Physical, chemical, and biological restoration• Indigenous knowledge of restoration• Linking ecological restoration with Human well-being and services	15
02	Module 2 -Assessment, Planning and Methods in Restoration Ecology <ul style="list-style-type: none">• Site assessment and baseline data collection• Setting restoration goals and objectives• Developing restoration plans and strategies• Soil and water management, Native species reintroduction, Habitat creation and enhancement• Monitoring and adaptive management• Case studies on ecological restoration of various ecosystems (Rivers, mines, forests, wetlands, etc.)	15



References:

1. Ecology, Environmental Science & Conservation. (2014). India: S. Chand Pvt. Limited.
2. Restoration of Nature by Prakash Gole
3. Restoration Ecology the new frontier – edited by Jelte Van Andel and James Aronson – Wiley-Blackwell publication ISBN 9781444336368
4. A source book for Ecological Restoration, Foundation for Ecological Security 2008
5. Ecological restoration, A practical approach, Steven I, Apfelbaum applied ecological services



Occupational Health and Safety

COURSECODE : U25ES6E02

COURSECREDIT:02 (02theory)

1credit-15 lectures

1lectureis60minutes

Course Objective:

CO1: To Provide a comprehensive understanding of occupational health, safety, and environmental management.

CO2: To familiarize students with occupational hazards, common diseases, and safety measures in workplaces.

CO3: To explain the role of safety regulations, standards, and performance measurements in industries.

CO4: To Equip students with knowledge about safety management systems, legal frameworks, and software applications in safety, health, and environment management.

Course Outcome:

CO1: Learn the basics of Occupational Health Hazards.

CO2: Learn the common occupational diseases.

CO3: Get acquainted with the principles of ergonomics.

CO4: Familiarise with Process Safety Management (PSM) as per OSHA.

Sr. No	Syllabus	No. of lectures
01	Module 1: Introduction to Occupational hazard <ul style="list-style-type: none">• Definition of Occupational Health as per WHO/ILO.• Occupational Health and Environmental Safety Management - Principles & practices.• Common Occupational diseases: Occupational Health Management Services at the workplace. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	15
02	Module 2: Monitoring for Safety, Health and Environment <ul style="list-style-type: none">• Occupational Health and Environment Safety Management System, ILO and EPA Standards.• Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.• Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Route of entry to human system, recognition, evaluation and control of basic hazards, concepts of dose response relationship, biochemical action of toxic substances. Concept of threshold, limit values, Types of Notifiable Diseases: Pneumoconiosis, Silicosis, Asbestosis, Bagassosis, Byssiniosis.	15



03	<p>Module 3: Occupational Health and Environmental Safety Education</p> <p>Element of training cycle, Assessment of needs. Techniques of training design and development of training programs. Training methods and strategies. Evaluation and review of training programs. • Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit • Ergonomics Introduction, Definition Objectives, Advantages. Ergonomics Hazards. Musculoskeletal Disorders and Cumulative Trauma Disorders. Physiology of respiration cardiac cycle, muscle contraction, nerve conduction system etc Assessment of Workload based on Human physiological reactions. Permissible limits of load for manual Lifting and carrying. Criteria of fixation limits.</p>	15
04	<p>Module 4: Occupational Safety, Health and Environment Management</p> <p>• Bureau of Indian standards on safety and health 14489 - 1998 and 15001 - 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS - 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. • Importance of Industrial safety, role of safety department, Safety committee and function, Role and responsibilities of safety officer • Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis and use of modern methods of programming, storing and retrieval of MIS for Safety, Health and Environment. • SQA Computer Software Application and Limitations. iii. Status and future goals of computer utilization in Safety, Health and Environment (SHE) Services in Industries</p>	15

References:

1. Reese, C. D. (2018). Occupational Health and Safety Management: A Practical Approach, Third Edition. United Kingdom: CRC Press.
2. Rao, S. S. (2000). Industrial Safety Health And Environment Management Systems. India: Khanna.
3. Jain, R. K, Rao, S. S. (2006). Industrial Safety Health And Environment Management Systems. India: Khanna.
4. Encyclopaedia of Occupational Health and Safety. (1998). Switzerland: International Labour Office.
5. Slote, L. Handbook of Occupational



Geospatial Technology - Semester VI

COURSE CODE: U25ES6VSC01
1 credit - 15 lectures

COURSE CREDIT: 02
1 lecture is 60 minutes

Course Objectives

CO1: To introduce the fundamental concepts, components, and applications of geospatial technology, including GIS, remote sensing, and GPS.

CO2: To provide knowledge on GIS, GPS, and GNSS, focusing on data models, spatial analysis, and various environmental applications

Course Outcome:

1. Students will understand the principles of remote sensing, types of sensors, and their applications in environmental monitoring and land use.

2. Students will be able to apply GIS and GPS technologies for spatial in environmental analysis

Unit I:	Introduction to Geospatial Technology	15
	Definition and Scope of Geospatial Technology, Components: GIS, Remote Sensing, GPS, and Spatial Data Infrastructure, Evolution and Development of Geospatial Technology, Electromagnetic Radiation Fundamentals of Remote Sensing: Principles of Remote Sensing Types of Sensors and Platforms (Optical, Microwave, LiDAR), Image Acquisition and Processing Techniques. Applications in Environmental Monitoring and Land Use	
Unit II	Geographic Information System (GIS), Global Positioning System (GPS) & GNSS	15
	GIS Data Models: Raster and Vector, Spatial Data Collection and Database Management, Geospatial Analysis: Overlay, Buffering, and Network Analysis, Application in Urban Planning, Disaster Management, and Climate Studies, Principles of GPS and GNSS (Global Navigation Satellite Systems), Integration with GIS and Remote Sensing, Applications in Navigation, Surveying, and Environmental Studies	

References:

1. Geospatial Technology: Fundamentals and Applications" by Dr. P.K. Chouhan and Dr. A.K. Singh.
2. Geospatial Infrastructure, Applications and Technologies: India Case Studies- N.L. Sarda, P.S. Acharya, and S. Sen.
3. Geospatial Technologies in Land Resources Mapping, Monitoring and Management" edited by G.P. Obi Reddy, S.K. Singh, K. Srinivas, and A.K. Singh. "Introduction to Geospatial Technology" by Bradley A. Shellito.



Credits and Duration of On-the-Job Training (OJT):

- a) On-the-job training (OJT) will carry a weightage of Four Credits.
- b) Each student is required to complete one hundred and twenty clock hours of On-the-Job Training (OJT) .
- c) The OJT program is to be completed during Semester IV break.

According to the guidelines outlined in the National Education Policy (NEP), undergraduate students are expected to fulfill this requirement within the second semester VI.



The scheme of examination shall be divided into two parts:

- Internal assessment 40% i.e. 40 marks
- Semester end examination 60% i.e. 60 marks

(A) Internal Assessment 40 marks

Description	Marks
Internal tests of 20 marks each Q.1 Multiple choice Questions/True or False- 10 Marks Q.2. Attempt 2 questions out of 3 questions (5 marks each)-10 Marks	20
One Project and Viva voce/Presentation/Case studies/Assignments	15
Attendance and Class behavior	5
Total	40

B.Sc. ENVIRONMENTAL SCIENCES

Maximum Marks:

60

Duration: 2hr

Question 1: Unit I

Question 2: Unit II

Question 3: Unit III

Question 4: Unit IV

Question 5: Unit I to Unit IV (Mixed questions)

Instructions: i. All Questions are compulsory

ii. All questions carry equal marks

iii. Draw neat and labeled diagrams wherever necessary

Q.1. Answer any two questions from the following (Based on Unit I)

a. 06

b. 06

c. 06

Q.2. Answer any two questions from the following (Based on Unit II)

a. 06

b. 06

c. 06

Q.3. Answer any two questions from the following (Based on Unit III)

a. 06

b. 06

c. 06



Q.4. Answer any two questions from the following (MIXED LONG QUESTION UNIT I, II, III)–
(Major and Minor Paper)

- a. 06
- b. 06
- c. 06

Q.5. Answer any two questions from the following (Short Notes-Mixed Questions)

- a. 03
- b. 03
- c. 03
- d. 03
- e. 03
- f. 03

PRACTICAL EXAMINATION: Total Marks: 50

- 1. Major Experiment: 25 Marks
- 2. Minor Experiment: 15 Marks

VIVA: 05 Marks

Journal: 05 Marks

NOTE:

- 1. Practical examination to be conducted as per the practical Syllabus enlisted.
- 2. Candidates are required to present certified journal on the day of practical examination.

