GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

REVISED MINUTES

of the 9th Special Meeting of the

X ACADEMIC COUNCIL

Day & Date

Saturday, 30th July, 2022

Time

10.00 a.m.

Council Hall
Goa University

D 3.5	**Minutes of the Board of Studies in Environmental Science meeting held on 20.04.2022.** The Academic Council approved the minutes of the Board of Studies in Environmental Science meeting held on 20.04.2022 with the following suggestions: 1. The month and year mentioned in the heading of the Syllabus document to be corrected from September 2022 to August 2022. 2. The Course Codes for the PG programmes to be revised/changed. **(Action: Assistant Registrar Academic – PG)**
D 3.6	**Minutes of the Board of Studies in Sociology meeting held on 26.04.2022.** The Academic Council approved the minutes of the Board of Studies in Sociology meeting held on 26.04.2022 with the following suggestions: 1. The Course Codes for the PG programmes to be revised/changed. 2. The column indicating Lecture Hours per week in programme structure to be removed/deleted. **(Action: Assistant Registrar Academic – PG)**
D 3.7	**Minutes of the Board of Studies in Public Administration meeting held on 01.07.2022.** The Academic Council approved the minutes of the Board of Studies in Public Administration meeting held on 01.07.2022 with the following suggestions: 1. The duration for the internship to be specified. 2. The Course Codes for the PG programmes to be revised/changed. 3. Number of hours for the Course **PARSOC5 Community Engagement and Rural Development** to be corrected. 4. The proposed syllabus/structure for Semester III and Semester IV was deferred. **(Action: Assistant Registrar Academic – PG)**
D 3.8	**Minutes of the Board of Studies in Physics meeting held on 24.03.2022.** The Academic Council approved the minutes of the Board of Studies in Physics meeting held on 24.03.2022 with the suggestion to revise/change the Course Codes for the PG Programme. The discussion on the proposed syllabus/structure for Semester III and Semester IV was deferred. **(Action: Assistant Registrar Academic – PG)**
D 3.9	**Minutes of the Board of Studies in History meeting held on 25.04.2022.** The House did not consider the minutes of the Board of Studies in History as the Board had not recommended the syllabus for Semester II. The Chairperson expressed his displeasure on behalf of the House about the fact that in spite of the official intimation given almost four months in advance, the said Chairperson did not take up the matter in Board of Studies. The Chairperson, Board of Studies, was advised to hold a meeting of the Board of Studies and submit the Syllabus for Semesters I and II on an urgent basis. The Vice-Chancellor was authorized to approve the Syllabus on behalf of the Academic Council. **(Action: Assistant Registrar Academic – PG)**
D 3.10	**Minutes of the Board of Studies in Biochemistry meeting held on 22.04.2022.** The Academic Council approved the minutes of the Board of Studies in Biochemistry

X AC- 9 (Special)
30.07.2022

GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

F I N A L U P D A T E D A G E N D A

For the 9th Special Meeting of the

X ACADEMIC COUNCIL

Day & Date

30th July, 2022

Time

10.00 a.m.

Venue
Conference Hall
Administration Block

	i) The minutes are in order. ii) The minutes may be placed before the Academic Council with remarks if any. iii) May be recommended for approval of Academic Council iv) Special remarks if any: Nil Sd/- Signature of the Dean Date: 22-04-2022 Place: Goa University (Back to Index)
D 3.5	**Minutes of the Board of Studies in Environmental Science meeting held on 20.04.2022.** **Part A**. i. Recommendations regarding courses of study in the subject or group of subjects at the undergraduate level: Nil ii. Recommendations regarding courses of study in the subject or group of subjects at the postgraduate level: 1. **BOS members met on 20.04.2022 at 1430hrs in CF 20, Marine science Wing, School of Earth, Ocean and Atmospheric Sciences and discussed the following.** **i. Approval of M.Sc. / M.A. Environmental Program Structure and Syllabus of Semester I & II.** **ii. Any other business with the permission of the chair.** **Part B** i) Scheme of Examinations at undergraduate level: Nil ii) Panel of examiners for different examinations at the undergraduate level: Nil iii) Scheme of Examinations at postgraduate level: Nil iv) Panel of examiners for different examinations at post-graduate level: Nil **Part C.** 1. Recommendations regarding preparation and publication of selection of reading material in the subject or group of subjects and the names of the persons recommended for appointment to make the selection: Nil **Part D** i. Recommendations regarding general academic requirements in the Departments of University or affiliated colleges: Nil ii. Recommendations of the Academic Audit Committee and status thereof: Nil **Part E.** i. Recommendations of the text books for the course of study at undergraduate level: Nil ii. Recommendations of the text books for the course of study at post graduate level: Nil **Part F.** <u>Important points for consideration/approval of Academic Council</u> i. The important points/recommendations of BOS that require consideration/approval of Academic Council (points to be highlighted) as mentioned below.

	a. Approval of M.Sc. /M.A. Environmental Science Program Structure and Syllabus of Semester I & II is attached as Annexure I (refer page no.134) 1. The BOS members deliberated on the nomenclature, eligibility and the course structure and expressed concern over issue of two degrees (Arts and Science) with similar core courses. 2. The BOS members also expressed concern over the courses approved by BOS of other subject as this program is governed by this body. 3. The program structure and syllabus in Environmental Science (Semester I and II) was deliberated and few suggestions made by the Experts were incorporated and the same was approved. **ii. The declaration by the Chairperson that the minutes were readout by the Chairperson at the meeting itself.** Date: 20.04.2022 Sd/- Place: Goa University Campus Signature of the Chairperson **Part G**. The Remarks of the Dean of the Faculty i. The minutes are in order ii. The minutes may be placed before the Academic Council with remarks if any. iii. May be recommended for approval of Academic Council. iv. Special remarks if any. Date: 20.04.2022 Sd/- Place: Goa University Campus Signature of the Dean **(Back to Index)**
D 3.6	**Minutes of the Board of Studies in Sociology meeting held on 26.04.2022.** **Part A**. i) Recommendations regarding courses of study in the subject or group of subjects at the undergraduate level: Nil ii) Recommendations regarding courses of study in the subject or group of subjects at the postgraduate level: The Board discussed and approved the Courses to be taught for Semester I and II from the Academic Year 2022-2023 (See **Annexure I refer page no.170**) **Part B** **i)** Scheme of Examinations at undergraduate level: Nil **ii)** Panel of examiners for different examinations at the undergraduate level: NIL **iii)** Scheme of Examinations at postgraduate level: NIL **iv)** Panel of examiners for different examinations at post-graduate level: NIL **Part C.**

D 3.5 Minutes of the Board of Studies in Environmental Science meeting held on 20.04.2022.

Annexure I

M. Sc. / M. A. in Environmental Science
School of Earth, Ocean and Atmospheric Sciences, Goa University,
Taleigao Plateau, Goa, India - 403206.

Approved in the Board of Studies on 20.04.2022
Effective from September, 2022.

Why a programme in Environmental Science?

Environmental science has conventionally studied physical, chemical and biological processes in the Earth system (Lithosphere, hydrosphere, atmosphere, biosphere and cryosphere). Increasingly, it now incorporates nature-human interactions and the social, political and cultural processes which impact the planet. The anthropogenic pressures on the ecological processes have forced disciplinary boundaries to merge and a student of environmental science must understand the complex relationships that drive nature-human interactions. Sustainability is one of the grand challenges that human survival faces on planet Earth.

Why at Goa University?

Goa is a biodiversity-rich state with Western Ghats on one side and the Arabian sea on the other. It has both terrestrial as well as marine biodiversity that sustains human livelihoods and provides numerous ecosystem services.

Goa University is uniquely positioned to offer students a stimulating programme to study the human-environment interaction. The university has all conventional programmes along with frontier areas like biotechnology, data science, hospitality, marine science, microbiology, women's studies among others.

What the course offers?

Goa University has designed an unique two-year postgraduate programme in environmental science keeping the above grand challenge in mind. The programme is hosted by the School of Earth Ocean and Atmospheric Sciences (SEOAS) in collaboration with Departments of Botany, Biotechnology, Zoology, Microbiology, Philosophy, Sociology, History, Faculty of Life Sciences, Goa Business School, Manohar Parrikar School of Law, Governance and Public Policy, and School of Chemical Sciences. It is conceived as a multidisciplinary programme which will teach students how to combine skills and knowledge from a variety of domains. It will allow students to explore courses from a large number of disciplines and skill themselves in a manner that they feel best suits them for their knowledge pursuits. The programme will provide a holistic approach to understand environmental issues and undertake environmental impact assessments with diverse perspectives, frameworks and using multiple data sources. All students will undertake fieldwork and laboratory work, to experience different habitats, climates, land formations and social structures.

Eligibility for admission to M. Sc. Environmental Science

Graduate in any science subject including Medicine and B. Tech.

Eligibility for admission to M.A. Environmental Science

Graduate in any discipline including Medicine and B. Tech.

Course structure and assessment methods

M. Sc. / M. A. in Environmental Scienceis a two year programme. The initial stages (first two semesters) of a student's study include compulsory core and optional courses, which aim to impart a general understanding of environmental science and introduce the student to some of the main principles. The following two semesters will typically allow students to choose research specific optional and generic courses, allowing for growing specialization. Towards the end of the program, one is likely to have the opportunity to carry out research on a topic of one's choice. Assessment methods include essays, written discussions, exams, problem sheets, laboratory reports, field exercises, field notebooks and seminar presentations.

Key skills

Common skills gained from an Environmental Science degree include:

- Environmental Impact Assessment
- Numeracy and data analysis
- IT skills
- Research skills
- Laboratory and fieldwork
- Team work
- Self-management, including planning and meeting deadlines
- Critical evaluation
- Effective and professional communication, both spoken and written

M. Sc. / M. A. Environmental Science structure and syllabus (Semester I & II).

Sr. no.	Course code	Course name	No. of credits
Semester I			
Core Courses			
1	ESC-22-101	Environmental Issues and Perspectives	3
2	ESC-22-102	Fundamentals of Economics	3
3	ESC-22-103	Environmental Ethics	3
4	ESC-22-104	Biodiversity Conservation	3
5	ESC-22-105	Land, Ocean and Atmospheric Interactions	3
6	ESC-22-106	Environmental Impact Assessment I	1
Optional Courses			
7	ESO-22-107	Coastal Ecology	1
8	ESO-22-108	Mangrove Ecology	1
9	ESO-22-109	Mangrove Restoration and Conservation	1
10	ESO-22-110	Environmental Externalities andPolicy	1
11	ESO-22-111	Concept of Sustainable Development	1

12	ESO-22-112	Introduction to Environmental Valuation	1
13	ESO-22-113	Basics of Geo-spatial Analysis	1
14	ESO-22-114	Spatial Economic Analysis	1
Semester II			
Core Courses			
15	ESC-22-201	Ecology and Society	3
16	ESC-22-202	Climate Change	3
17	ESC-22-203	Environmental Geology	3
18	ESC-22-204	Basic Statistics	3
19	ESC-22-205	Environmental Management	3
20	ESC-22-206	Environmental Impact Assessment II	1
Optional Courses			
21	ESO-22-207	Mineral ResourceManagement	1
22	ESO-22-208	Pollution and Environment	1
23	ESO-22-209	Natural and Manmade Hazards	1
24	ESO-22-210	Marine Habitat Conservation and Restoration	1
25	ESO-22-211	Ecological significance of symbiosis	1
26	ESO-22-212	Nitrogen and Climate Change	1
27	ESO-22-213	Environment and Literature	2
28	ESO-22-214	Gender Sensitivity and Equity	2

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Semester I

Title of the Course:Environmental Issues and Perspectives

Course Code: ESC-22-101

Number of Credits: 03

Prerequisites for the course:	There is no prerequisite for this course apart from the program requirements	
Objective:	This course is an invitation to the study of environment in its multiple nuances. While familiarising environmental issues, the course also intends to introduce students to perspectives on environment.	
Content:	**Module 1: Introduction to Environment** Concept of environment and types of environment Environmental heritage and human dimension of environmental science	06 hours

	Interdisciplinary and multidisciplinary approaches to environment and major themes – biological, ecological and social ecological orientations **Module 2: Human population and environment** Basic concepts of population dynamics, population growth, demographic transition, human population effects on Earth. Environmental systems and ecosystems: Concepts and fundamentals. **Module 3: Environmental issues and concerns** Environmental conservation, Food and agriculture Environmental health, pollution and toxicology Climate and global warming Solid and hazardous waste **Module 4: Social issues and environment** Urban growth and industrial planning Development, displacement and rehabilitation Ideologies of environmentalism Towards articulating sustainable environmental future	09 hours 15 hours 15 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations	
References/ Readings	1. Basu, M., & Xavier, S. (2016). *Fundamentals of environmental studies.* Cambridge University Press. 2. Carolyn, M. (Ed.). (1996). *Ecology*. Rawat Publications. 3. Gadgil, M., &Guha, R. (2000). *Use and abuse of nature.* Oxford University Press. 4. Gadgil, M., &Guha, R. (1995). *Ecology and equity.* Oxford University Press. 5. Guha, R. (2000). *Environmentalism: A global history.* Oxford University Press. 6. Joseph, B. (2009). *Environmental studies* (2nd ed).Tata McGraw Hill. 7. Krishna, S. (1996). *Environmental politics.* Sage Publications. 8. Rangarajan, M. (Ed.). (2007). *Environmental issues in India: A reader.* Dorling Kindersley.	
Learning Outcomes	1. Students are introduced to the multi-dimensional feature of environmental reality. 2. They are familiarized with the plural perspectives on environment both as an academic focus and lived-in reality.	

Title of the Course: Fundamentals of Economics
Course Code: ESC-22-102
Number of Credits: 03

Prerequisites for the Course:	There is no prerequisite for this course apart from the program requirements

Objective:	The aim of the course is to introduce students to the basic concepts, theories and principles that will provide the foundation for a proper understanding of how an economy works. The syllabus seeks to equip students with the basic tools necessary for an understanding and interpretation of economic issues affecting the economy.	
Content:	**Module 1: Introduction** Scope and method of economics; Building blocks of modern economy – agents, resources and classification of goods. **Module 2:Microeconomic analysis** Consumer equilibrium, producer equilibrium, market equilibrium, general equilibrium and possible disequilibrium situations. **Module 3: Macroeconomic analysis** Circular flow and national income, issues related to growth, unemployment and inflation. **Module 4:Public economics and international trade** Market failure, Taxation and Quotas, Efficiency versus Equity. Balanced budgets and Debt financing. International Trade: Comparative advantage theory, gains from trade; tariffs and protection, exchange rates.	06 hours 09 hours 15 hours 15 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations	
References/ Readings	1. Banerjee, A., &Duflo, E. (2019). *Good economics for hard times: Better answers to our biggest problems*. Penguin Books. 2. Dasgupta, P. (2010). *Economics: A very short introduction*. Sterling Pub. 3. Mankiw, G. (2020). *Principles of economics* (9th ed).Cengage Learning, Asia. 4. Samuelson, P., Nordhaus, W, Chaudhuri S., &Sen A. (2010). *Economics* (19th ed). McGraw-Hill.	
Learning Outcomes	1. The students will be able to understand the basic concepts-principles and theories of Economics. 2. This course will enable the students to understand and analyse different types of equilibrium, circular flow of the economy and factors affecting growth and employment in an economy. 3. The students will learn the basics of international trade and fundamental concepts in public economics.	

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Title of the Course:Environmental Ethics
Course Code: ESC-22-103
Number of Credits: 03

Prerequisites for the course:	There is no prerequisite for this course apart from the programme requirements	
Objectives:	1. To analyse different approaches and broad theories of environmental philosophy. 2. Understand the philosophical basis of various conservative theories.	
Contents:	**Module 1: Introduction** Introduction to environmental ethics **Module 2:Value and Nature** Value and Nature: Moral theories (Consequentialism, Virtue Ethics and Kantianism), Intrinsic value and Instrumental values, anthropocentrism. **Module 3: Ecology** Land ethics & deep ecology, Bio centrism, Eco-centrism, Speciesism, Culture and ecology.	05 hours 20 hours 20 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations	
References/ Readings	1. Jaquet, F. (2019). Is Speciesism Wrong by Definition? *Journal of Agricultural and Environmental Ethics, 32 (3)*. 2. Kopnina, H., Washington, H., Taylor, B., & Piccolo, J.J.(2018). Anthropocentrism: More than Just a Misunderstood Problem. *Journal of Agricultural and Environmental Ethics, 31.* 3. Sandler, R. (2017). *Environmental Ethics: Theory in Practice*. Oxford University Press. 4. Attfield, R. (2014). *Environmental Philosophy*. Polity Press. 5. Jamieson, D. (2008). *Ethics and Environment- An Introduction*. Cambridge University Press. 6. Grim, J.A .(Ed.). (2001.). *Indigenous Traditions and Ecology- The Inter-being of Cosmology and Community.* Harvard University Press. 7.Taylor, P. W. (1986). *Respect for Nature: A Theory of Environmental Ethics.* Princeton University Press. 8. Passmore, J. (1974). *Man's Responsibility for Nature*. Charles Scribner's son.	
Learning Outcomes	1. Students will be able to learn and evaluate different theories of environmental ethics. 2. Realize the significant role and responsibility towards the protection of the environment.	

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Title of the Course:Biodiversity Conservation
Course Code: ESC-22-104
Number of Credits: 03

Prerequisite for the course:	There is no prerequisite for this course apart from the program requirements	
Objective:	The course provides the fundamentals about ecosystems, their types, distribution, components, functioning, services and their role in biodiversity. Biotic components of ecosystems, fundamentally understood as Biodiversity, their measure, and factors that lead to enormous biodiversity, and essential components that maintain biodiversity. More importantly, knowledge on their resilience and thresholds, which are required for management and conservation of both biodiversity and ecosystems will be imparted.	
Content:	**Module 1: Introduction** Ecosystems - Development of concept and the current understanding; Ecosystem as a system. Structural and Functional components of Ecosystems. Ecological complexity. Energy flow in ecosystems; adaptive cycle view of ecosystem development and change; Ecosystem attributes and functioning. Thermodynamics and Information theory in ecosystems. Types of ecosystems, their distribution and composition. Case study - Tropical rain forests ecosystem. **Module 2: Ecosystems processes and applications** Role of species in ecosystem functioning. Applications of ecosystems knowledge. Ecosystem services. Measuring Ecosystem Health. Ecosystem Processes; Controls over Ecosystem Processes. Human-Induced Ecosystem Change: Human Impacts on Ecosystems, Resilience and Threshold Changes, Degradation in Ecosystem Services. **Module 3: Biodiversity** Definition; the past (diversity and extinction) and present; major groups of biological organisms; evolution of biodiversity and drivers of biodiversity. The role of geology and climate in their distribution. Patterns in biodiversity: Spatial and temporal patterns at genetic, species and taxonomic diversity, Approaches	09 hours 09 hours 09 hours

	to biodiversity studies. Loss of biodiversity and biodiversity targets 2020. **Module 4: Measuring Biodiversity** Species richness and Biodiversity Indices (diversity and evenness indices); Methods of Measuring Biodiversity; Alpha, Beta and Gamma-diversity; Genetic, Species and Ecosystem Diversity; Centres of plant diversity, Hotspots of Biodiversity and their distribution; Drivers of biodiversity change. **Module 5: Biodiversity of India** Bio-geographical regions of India; Forest types and major ecosystems of India. Major groups of organisms and their diversity. Endemism. Concepts of keystone, umbrella and flagship species.	09 hours 09 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations.	
References/ Readings	1. Chapman, J. L., &Reiss, M. J.(1999). *Ecology: Principles and applications*(2nded). Cambridge University Press. ISBN: 0521588022, 9780521588027. 2. Kormondy, E. J.(2017).*Concepts of ecology*(4thed) p. 978-9332586093. PubMed: 9332586098; ISBN-13. Pearson. 3. Singh, J.S., Singh, S.P., &Gupta, S.R.(2014). *Ecology*.Environmental Science& Conservation. Chand, S.*Publishing*. ISBN: 9383746009, 9789383746002. 4. Begon, M., Howarth, R.W., &Townsend, C.R.(2014). *Essentials of ecology*(4th Ed). ISBN: 1118802373, 9781118802373. 5. Bowman, W.D., Hacker, S.D., &Cain, M.L.(2020). *Ecology*(5thed). Oxford University Press, Incorporated. ISBN: 160535922X, 9781605359229. 6. ChapinIII, S.F.,Matson, P.A., &Vitousek, P.(2011). *Principles of terrestrialecosystemecology*(2nded). Springer. ISBN: 1441995048, 9781441995049. 7. Gaston, K.J., &Spicer, J.I.(2004).*Biodiversity: Anintroduction*(2nded). Blackwell Science. ISBN: 978-1-405-11857-6. 8. Gaston, K.J.(Ed.).(1996). *Biodiversity: Abiology of numbers and difference*. PubMed: 0865428042. Blackwell Science. ISBN: 978-0865428041 9. Groombridge, B., &Jenkins, M.D.(2002). *World Atlas of biodiversity: Earth's Living Resources in the 21stCentury*.University of California Press. ISBN: 0520236688, 9780520236684.	

	10. Henderson, P.A., &Southwood, T.R.E.(2016). *Ecological methods*(4th ed). John Wiley & Sons. ISBN:1118895282, 9781118895283. 11. Jørgensen, S., Xu, L., &Costanza, R.(2016). *Handbook of ecologicalindicators for assessment of ecosystemhealth*(2nd ed). CRC Press. ISBN: 1439809372, 9781439809372. 12. Jorgensen, S. E.(Ed.).(2009). *Ecosystem ecology*. Elsevier. ISBN: 0444534660, 9780444534668. 13. Krebs, C.J.(2013). *Ecology: Theexperimentalanalysis of distribution and abundance*(6th ed). Pearson. ISBN: 1292026278, 9781292026275. 14. Raffaelli, D.G., &Frid, C.L.J.(Eds.).(2010). *Ecosystem ecology: Anewsynthesis*. Cambridge University Press. ISBN: 1139486144, 9781139486149. 15. Smith, T.M., &Smith, R.L.(1988). Biodiversity in E.O. Wilson(Ed.). *Elements of ecology*(9th ed). Pearson. ISBN: 1292077409. National Academy Press, 9781292077406. ISBN: 030956736X, 9780309567367.	
Learning Outcomes	After successful completion of the course, students will be able to: 1. Understand and interpret the structure, variables, processes and functions operating in ecosystems. 2. Foresee how the alteration of the components would affect the ecosystem and its functions. 3. Able to see the connectivity among all the components of ecosystems and their services. 4. Understand the importance of biodiversity and methods to measure it. 5. Understand the threshold of resilience and predict the impact of removal of a species in an ecosystem.	

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Title of the Course:Land, Ocean and Atmospheric interactions
Course Code: ESC-22-105
Number of Credits: 03

Prerequisites for the course:	There is no prerequisite for this course apart from the program requirements	
Objective:	The course will impart an insight to the students about the need for an integral approach to study an ecosystem.	
Content:	**Module 1: Introduction** Earth system science; Evolution of geosphere, biosphere, atmosphere, hydrosphere and cryosphere; Properties of sea and	06 hours

	fresh water - distribution of temperature, salinity, density and oxygen in space and time. **Module 2:** Optical characteristics of sea water; Water type and masses: formation and classification, identification of water masses. General circulation of the world ocean; Wind driven and thermohaline circulation; Indian monsoon circulation. Tides- generation and propagation, characteristics of tides, spring and neap tides. **Module 3:** Atmospheric instability and convection-stability criteria; Mixing and convective condensation levels; Potential instability and latent instability; Cloud formation and types; Laws of black body radiation; Solar radiation transfer; Latitudinal and seasonal variation, absorption, scattering and reflection; Photosynthetically available radiation; Terrestrial radiation; Low and high pressure. **Module 4:** Upwelling and downwelling; Major and minor nutrients; Residence time; Dissolved gases; Marine habitats; Marine photosynthesis; Photosynthetic pigments; Biological productivity; Gross and net productivity; Redfield ratio; New and regenerated productivity; Food chain and food web; Exclusive economic zone.	09 hours 15 hours 15 hours
Pedagogy:	Use of conventional, online and ICT Methods. Lecture/Tutorials/Assignments	
References/ Readings	1. Wallace, J.M., &Hobbs, P.V. (2006). *Atmospheric science: Anintroductorysurvey*(2nd ed).Elsevier Academic Press. 2. Marshall, J., &Plumb, R.A. (2008).Atmosphere ocean and climatedynamics: Anintroductory.*Textile*.Elsevier Academic Press. 3. Hess, L.S. (1959). *Introduction to theoreticalmeteorology*.Holt, Rinehart & Winston, New York. 4. Houghton, J. T. (2002).*Physics of the atmosphere*.Cambridge University Press. 5. Stewart, R.L.(2008).*Introduction to physicaloceanography*. Department of Oceanography, Texas A&M University. 6. Open University Course Team(1999).*Waves, tides and shallowwaterprocesses*. Butterworth-Heinemann Publications. 7. Williams, F.J., &Elder, S. (1989). *Fluid Physics for Oceanographers and Physics: An introduction to incompressible.*Butterworth-Heinemann, England. 8. Sverdrup, H.U., Johnson, M.W., &Flemming, R.H. (1962). *The ocean: Theirphysics, chemistry and biology*.Asia Publishing House.	

	9. Miller, C.B., &Wheeler, P.A.*Biological oceanography*. (2nd ed). Wiley-Blackwell Publishers. 10. Grant Gross, M. (1990). *Oceanography* (5th ed).Prentice Hall. 11. Thurman, H.V., &Mercill, C. (1988). *Introductory oceanography* (5th ed) Publ. CO, OH. 12. Talley, L.D., Pickard, G.L., Emery, W.J., &Swift, J.H. (2011). *Descriptive physicaloceanography*(6th ed).Elsevier. 13. Lenton, T. (2016). *Earth systemscience: Averyshortintroduction*(1st ed).Oxford University Press. 14. Ehlers, E., &Kraft, T.*Earth systemscience in the Anthropocene: Emergingissues and problems.* Springer.	
Learning Outcomes	Understanding the interrelation between each component of Earth system to decipher meaningful information of an ecosystem.	

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Title of the Course:Environmental Impact Assessment - I
Course Code:ESC-22-106
Number of Credits: 01

Prerequisites for the course:	There is no prerequisite for this course apart from the programme requirements	
Objective:	In order to overcome the problems of environmental degradation, it is very necessary to plan the development process in a sustainable manner so that control and mitigation measures can be undertaken prior to occurrence of degradation. One important tool to do this is carrying out Environmental Impact Assessment. Hence, knowledge of this subject is very important for an environmental engineer.	
Content:	**Module 1: Introduction to the Environmental Impact Assessment process** • **Introduction and principals:** Introduction; nature and purpose of EIA; Project, Environment and nature of Impacts; Changing perspective and current issues in EIA; EIA regulations. • **Starting up early stages:** Managing the EIA process; project screening, scoping; understanding the project/development action; establishing the environmental baseline; impact identification. • **Participation, presentation and review:** Impact prediction; Evaluation; mitigation and enhancement; public consultation and participation; the importance of monitoring and auditing in the EIA process; Monitoring and auditing practice; EIA presentation and review. • **Practice and prospects:** Legal Challenges, cost and benefits of EIA; Case studies of EIA in practice; strategic environmental assessment; extending EIA to project implementation.	15 hours

Pedagogy:	Lectures/assignments/workshops/ street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations.	
References/ Readings	1. Glasson, J., Therivl, R., &Chadwick, A.(2005). *Introduction to environmentalimpactassessment*. Routledge, Taylor &Francis Group. 2. Arts, J., &Morrison-Saunders, A.(Eds.). (2012). *Assessing impact: Handbook of EIA and SEA follow-up*. Routledge, Taylor &Francis Group. 3. Abaza, H., Bisset, R., &Sadler, B.(2004). *Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated approach*. UN Environmental Program. 4. Therivel, R., &Wood, G.(Eds.). (2017). *Methods of environmental and social impact assessment*. Routledge, Taylor &Francis Group. 5. Morris, P., &Therivel, R.(Eds.). (2001). *Methods of environmental impact assessment*, *2*. Taylor & Francis.	
Learning Outcomes	After learning the course the students should be able to: 1. Explain the need for EIA 2. Define EIA 3. Demonstrate the understanding of concept of Sustainable Development and justify the methods of achieving SD. 4. Appreciate the importance of EIA as an integral part of planning process. 5. Apply the different methodologies to predict and assess the impacts of minor/major projects on various aspects of environment. 6. Enumerate the role of public participation in environmental decision making process. 7. Characterize the environmental attributes.	

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Title of the Course: Coastal Ecology
Course Code: ESO-22-107
Number of Credits: 01

Prerequisites for the course:	Graduates in any discipline with science subjects at 10+2 level.	
Objective:	To introduce the students to the dynamic mangrove ecosystem, its composition – abiotic and biotic, benefits, threats and need for conservation.	
Content:	**Module 1: Introduction** Mangroves, global distribution, current status, threats, ecology and environment, relation with other ecosystems, uses of mangroves. **Module 2: Structure and function of mangrove ecosystem** Physical mangrove environment, forest types – overwashed,	02 hours 13 hours

	fringe, dwarf, riverine, basin, hammock; true mangroves – red, white, green, black; mangrove associates, adaptations in mangroves, patterns and processes in mangrove ecosystem, environmental factors - climate and habitats Biodiversity in mangrove ecosystem: flora and fauna	
Pedagogy:	Lectures/ case studies/ tutorials/ videos/ assignments/ self-study/ visits	
References/ Readings	1. Kathiresan, K., &Ajmal Khan, S. (2005). UNU-INWEH-UNESCO International training course on Coastal Biodiversity in Mangrove Ecosystem- Course manual (pp. 410). Annamalai University, India. 2. FAO (2007). The world's mangroves: 1980–2005. FAO, Rome, Italy. 3. Sandilyan, S., &Kathiresan, K. (2012). Mangrove conservation: a global perspective. *Biodiversity Conservation*, *21*, 3523–3542. 4. Nagelkerken, I., Blaber, S.J.M., & Bouillon, S. et al. (2008). The habitat function of mangroves for terrestrial and marine fauna: a review. *Aquatic Botany, 89*, 155–185. 5. Nanjo, K., Kohno, H., Nakamura, Y., Horinouchi, M., & Sano, M. (2014). Effects of mangrove structure on fish distribution patterns and predation risks. *Journal of Experimental Marine Biology and Ecology, 461,* 216–225. 6. Shinnaka, T., Sano, M., Ikejima, K., Tongnunui, P., Horinouchi, M., &Kurokura, H. (2007). Effects of mangrove deforestation on fish assemblage at Pak Phanang Bay, Southern Thailand. *Fisheries Science, 73*, 862–870. 7. 1st International Training Course onMangrove Ecosystems in the Western Indian Ocean Region. (December 2-9, 2013) Mombasa, Kenya. UNU-INWEH-UNESCO. 8. Singh, V.P., &Odaki, K. (2004). *Mangrove ecosystem: structure and function.* Scientific Publishers, Jodhpur, India.	
Learning Outcomes	Students will gain knowledge about mangrove ecosystem, its floral and faunal biodiversity.	

Title of the Course: Mangrove Ecology
Course Code: ESO-22-108
Number of Credits: 01

Prerequisites for the course:	Graduates in any discipline with science subjects at 10+2 level.
Objective:	To introduce the students to the dynamic mangrove ecosystem, its composition – abiotic and biotic, benefits, threats and need for conservation.

Content:	**Module 1: Introduction** Mangroves, ecology and environment, uses of mangroves, threats to mangrove. **Module 2: Ecological importance of mangrove ecosystem and the impact of anthropogenic activities** Functional aspects – biomass, productivity, litter and its decomposition, carbon sink and organic carbon productivity, nitrogen and sulfur cycling, nutrient status, nurseries, biofilters for toxic pollutants, breeding grounds – fish, birds; mitigation of climate change, coastal defence mechanism Indigenous people of mangroves – livelihood dependency –Case study on Sunderban Anthropogenic destruction - deforestation, landfills, land reclamation, waste disposal sites, pollution – water quality and persistent chemicals, loss of mangrove biodiversity.	02 hours 13 hours
Pedagogy:	Lectures/ case studies/ tutorials/ videos/ assignments/ self-study/ visits	
References/ Readings	1. Kathiresan, K., &Ajmal Khan, S. (2005). UNU-INWEH-UNESCO International training course on Coastal Biodiversity in Mangrove Ecosystem- Course manual (pp. 410). Annamalai University, India. 2. FAO (2007). The world's mangroves: 1980–2005. FAO, Rome, Italy. 3. Nagelkerken, I., Blaber, S.J.M., & Bouillon, S. et al. (2008). The habitat function of mangroves for terrestrial and marine fauna: a review. *Aquatic Botany, 89*, 155–185. 4. Nanjo, K., Kohno, H., Nakamura, Y., Horinouchi, M., & Sano, M. (2014). Effects of mangrove structure on fish distribution patterns and predation risks. *Journal of Experimental Marine Biology and Ecology, 461,* 216–225. 5. Shinnaka, T., Sano, M., Ikejima, K., Tongnunui, P., Horinouchi, M., &Kurokura, H. (2007). Effects of mangrove deforestation on fish assemblage at Pak Phanang Bay, Southern Thailand. *Fisheries Science, 73*, 862–870. 6. 1st International Training Course onMangrove Ecosystems in the Western Indian Ocean Region. (December 2-9, 2013) Mombasa, Kenya. UNU-INWEH-UNESCO. 7. Singh, V.P., &Odaki, K. (2004). *Mangrove ecosystem: structure and function.* Scientific Publishers, Jodhpur, India.	
Learning Outcomes	1. Imprint the importance of mangroves in maintaining the global climate and balance in the nutritional as well as biogeochemical cycles. 2. Awareness about indigenous people and anthropogenic destruction	

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Title of the Course: Mangrove Restoration and Conservation
Course Code:ESO-22-109
Number of Credits: 01

Prerequisites for the course:	Graduates in any discipline with science subjects at 10+2 level.	
Objective:	To introduce the students to the dynamic mangrove ecosystem, its composition – abiotic and biotic, benefits, threats and need for conservation.	
Content:	**Module 1: Introduction** Mangroves, global distribution, current status, threats, uses of mangroves. **Module 2: Restoration and conservation** Restoration and afforestation projects, ecosystem based management, protected areas, restoration tools, monitoring methods – remote sensing and GIS, awareness programmes, training programmes, community based management, role of institutions, NGOs, global conservation strategies, economic valuation (cost benefit analysis), national and global mangrove conservation policies, conservation and mangrove protection laws, international agreements – Ramsar convention, case study – mangroves of Goa.	02 hours 13 hours
Pedagogy:	Lectures/ case studies/ tutorials/ videos/ assignments/ self-study/ visits	
References/ Readings	1. Kathiresan, K., &Ajmal Khan, S. (2005). UNU-INWEH-UNESCO International training course on Coastal Biodiversity in Mangrove Ecosystem- Course manual (pp. 410). Annamalai University, India. 2. FAO (2007). The world's mangroves: 1980–2005. FAO, Rome, Italy. 3. Sandilyan, S., &Kathiresan, K. (2012). Mangrove conservation: a global perspective. *Biodiversity Conservation*, *21*, 3523–3542. 4. Nagelkerken, I., Blaber, S.J.M., & Bouillon, S. et al. (2008). The habitat function of mangroves for terrestrial and marine fauna: a review. *Aquatic Botany, 89*, 155–185. 5. Nanjo, K., Kohno, H., Nakamura, Y., Horinouchi, M., & Sano, M. (2014). Effects of mangrove structure on fish distribution patterns and predation risks. *Journal of Experimental Marine Biology and Ecology, 461,* 216–225. 6. Shinnaka, T., Sano, M., Ikejima, K., Tongnunui, P., Horinouchi, M., &Kurokura, H. (2007). Effects of mangrove deforestation on fish assemblage at Pak Phanang Bay, Southern Thailand. *Fisheries Science, 73*, 862–870. 7. 1st International Training Course onMangrove Ecosystems in the Western Indian Ocean Region. (December 2-9, 2013) Mombasa, Kenya. UNU-INWEH-UNESCO.	

	8. Singh, V.P., &Odaki, K. (2004). *Mangrove ecosystem: structure and function.* Scientific Publishers, Jodhpur, India.	
Learning Outcomes	This paper will highlight the need to conserve and protect the mangroves.	

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Title of the Course:Environmental Externalities and Policy
Course Code:ESO-22-110
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline from a recognised University	
Objective:	This course aims to equip the learner with tools of resource allocation using basic concepts in Economics. This will include market and non-market-based approaches to understanding problems of global and local pollution and challenges to sustainability using techniques of environmental valuation.	
Content:	**Module 1: Introduction** Meaning of externalities, environmental policy in the presence of externalities. **Module 2: Theory of externalities & environmental policy** Missing Markets, Non-convexity, Non-linearity, Public Goods, Common Property Resources, Coase Theorem and Issues in Property Rights; Pigouvian Taxes, Subsidies, Tradable Permits, Price v/s Quantity tools.	02 hours 13 hours
Pedagogy:	In class/online lectures, assignments, group activities, presentations.	
References/Readings	1. 1. Harris, J.M., & Roach, B. (2021). *Environmental and Natural Resource Economics: A Contemporary Approach*. Routledge. 2. Kolstad, C. (2012). *Intermediate Environmental Economics*. Oxford University Press. 3. Perman, R, Ma Y., Common, M., Maddison, D, &McGilvray. (2011). *Natural Resource and Environmental Economics* (4thed). Addison Wesley. 4. Rondeau, D., & Conrad, J.M. (2020). *Natural Resource Economics: Analysis, Theory, and Applications*. Cambridge University Press. 5. Tietenberg, T. (2000). *Environmental and Natural Resource Economics* (5thed). Addison Wesley.	
Learning Outcomes	On successful completion, course participants will be able to: 1. Understand how the environmental resources affect human welfare. 2. Have an informed opinion on environment-development trade-offs. 3. Assess international challenges of sustainability.	

Title of the Course:Introduction to Sustainable Development

Course Code: ESO-22-111
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline from a recognised University	
Objective:	This course aims to equip the learner with tools of resource allocation using basic concepts in Economics. This will include market and non-market based approaches to understanding problems of global and local pollution and challenges to sustainability using techniques of environmental valuation.	
Content:	**Module 1: Introduction** Meaning of sustainable development. **Module 2: Sustainable development** Renewable and Non-renewable Resources - Optimal use under different market Structures. Strong and weak sustainability; Global agreements, Economics of ecosystems and biodiversity. Issues of climate change adaptation and mitigation.	02 hours 13 hours
Pedagogy:	In class/online lectures, assignments, group activities, presentations.	
References/Readings	1. Harris, J.M., & Roach, B. (2021). *Environmental and Natural Resource Economics: A Contemporary Approach*. Routledge. 2. Kolstad, C. (2012). *Intermediate Environmental Economics*. Oxford University Press. 3. Perman, R, Ma Y., Common, M., Maddison, D, &McGilvray. (2011). *Natural Resource and Environmental Economics* (4th ed). Addison Wesley. 4. Rondeau, D., & Conrad, J.M. (2020). *Natural Resource Economics: Analysis, Theory, and Applications*. Cambridge University Press. 5. Tietenberg, T. (2000). *Environmental and Natural Resource Economics* (5th ed). Addison Wesley.	
Learning Outcomes	On successful completion, course participants will be able to: 1. Understand how the environmental resources affect human welfare. 2. Have an informed opinion on environment-development trade-offs. 3. Assess international challenges of sustainability	

Title of the Course:Introduction to Environmental Valuation
Course Code: ESO-22-112
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline from a recognised University
Objective:	This course aims to equip the learner with tools of resource allocation using basic concepts in Economics. This will include market and non-market based approaches to understanding problems of global and local pollution and challenges to sustainability using techniques of environmental valuation.

Content:	**Module 1: Introduction** Meaning, importance of environmental valuation. **Module 2: Issues in valuation** Costs and benefits. Use values, Non-use values, Option values, Discount rates. Methods of valuation: Revealed and stated preferences; Market and non-market valuation; Applications of valuation in developing countries.	02 hours 13 hours
Pedagogy:	In class/online lectures, assignments, group activities, presentations.	
References/Readings	1. Harris, J.M., & Roach, B. (2021). *Environmental and Natural Resource Economics: A Contemporary Approach*. Routledge. 2. Kolstad, C. (2012). *Intermediate Environmental Economics*. Oxford University Press. 3. Perman, R, Ma Y., Common, M., Maddison, D, &McGilvray. (2011). *Natural Resource and Environmental Economics* (4th ed). Addison Wesley. 4. Rondeau, D., & Conrad, J.M. (2020). *Natural Resource Economics: Analysis, Theory, and Applications*. Cambridge University Press. 5. Tietenberg, T. (2000). *Environmental and Natural Resource Economics* (5th ed). Addison Wesley.	
Learning Outcomes	On successful completion, course participants will be able to: 1. Understand how the environmental resources affect human welfare. 2. Have an informed opinion on environment-development trade-offs. 3. Assess international challenges of sustainability.	

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Title of the Course: Basics of Geo-spatial Analysis
Course Code: ESO-22-113
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline with science subjects at 10+2 level.	
Objective:	Introduce learners to understanding spatial data and its applications	
Content:	**Module 1: Introduction** Introduction to remote sensing and GIS. Application remote sensing and GIS, sources of information on remote sensing data. **Module 2: Spatial Analysis** Raster and vector data, Analysing raster data -clipping, analyzing elevation, terrain and raster calculator,Analysing vector- creating shapefile, attribute table, field calculator and data joins, Layer styling, zonal statistics, print layout.	03 hours 12 hours

Pedagogy:	Lectures/ class discussion/case studies/ assignments	
References/ Readings	1. Chuvieco, E. (2016). *Fundamentals of satellite remote sensing: An environmental approach.* CRC press. 2. Cutts, A.,Graser, A.(2018).*Learn QGIS, Your Step-by-step Guide to the Fundamental of QGIS 3.4*(4th ed).Packt Publishing,Livery Place, UK. 3. Menke, K.et. al. (2016).*Mastering QGIS*.Packt Publishing, Livery Place, UK.	
Learning Outcomes	Candidates will be able to extract and process spatial images using open source software for economic decision-making.	

Title of the Course: Spatial Economic Analysis
Course Code: ESO-22-114
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline with science subjects at 10+2 level.	
Objective:	1. To introduce spatial economic analysis to the students to make them understand the development and growth process. 2. To expose the students to toolsthatintegrate GIS (Geographic Information System) and remote sensing in order to analyse economic change.	
Content:	**Module 1: Introduction** Fundamentals of Remote Sensing Signals, Electromagnetic Spectrum, Spectral Signatures in the Solar Spectrum. **Module 2:Remote sensing applications in urban socio-economic analysis** Principles of urban socio-economic studies using remote sensing technologies, Socio-economic information estimation- Population estimation, Employment estimation, GDP estimation, Electrical power consumption estimation, Land use land cover, Advantages and limitations of remote sensing technologies in socio-economic applications.	03 hours 12 hours
Pedagogy:	Lectures/ class discussion/case studies/ assignments	
References/ Readings	1. Chuvieco, E. (2016). *Fundamentals of satellite remote sensing: An environmental approach.* CRC press. 2. Mesev, V. (2007). *Integration of GIS and Remote Sensing*. John Wiley & Sons. 3. Cutts, A., Graser, A. (2018). *Learn QGIS, Your Step-by-step Guide to the Fundamental of QGIS 3.4(*4th ed).Packt Publishing, Livery Place, UK.	
Learning Outcomes	The students will be able to extract and process satellite images using open source software and use it to study economic and demographic change.	

Title of the Course: Ecology and Society
Course Code: ESC-22-201
Number of Credits: 03

Prerequisites for the course:	There is no prerequisite for this course apart from the programme requirements	
Objective:	The module on Goan Society, Gender and Ecology which is taught by faculty from the Women's Studies Programme of ManoharParrikar School of Law, Governance and Public Policy will introduce students to the politics behind the popular connect between women and nature, and will deliberate on the concerns regarding land, water and livelihoods, menstruation and environment with a focus on issues in Goa. The larger objective of ecology is to understand the nature of environmental influences on individual organisms, their populations, and communities, on eco-scapes and ultimately at the level of the biosphere. One core goal of ecology is to understand the distribution and abundance of living things in the physical environment and its importance to humans.	
Content:	**Module 1: Introduction** Introduction to Ecology & Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche, niche, width and overlap, resource partitioning. Environmental concepts: laws and limiting factors, ecological models. Ecological structure, Ethno-zoology: The study of the past and present interrelationships between human cultures and the animals in their environment. **Module 2: Ecology and society** Culture and cultural ecology, Environmental ethics, Community based conservation (Sacred Grooves etc.), Society and Laws (Environment Protection Act, Biodiversity Act etc.) **Module 3: Disciplinary traditions** An overview of disciplinary traditions and the study of Environmental issues. Society, culture and environment; Ecological consciousness and ecological conflicts.Environment, development and sustainable development. Environmental movements in India: Issues, ideologies and methods. **Module 4: Gender and Ecology in Goan Society** "Is Female to Male as Nature is to Culture" Sherry Ortner. Menstruation: Hygiene, Management, Eco-cultural practices and social exclusion. Forest Law, Tribes and Livelihood: Women's experiences in Goa - Kumeri cultivation, Social Ecology, Traditional knowledge, Power and Agency.	06 hours 09 hours 15 hours 15 hours

	Ecology, Livelihood and Gender: Water, Land ownership, Work, Participation and impacts (tourism, mining, agriculture, fishing, craft and small scale industry).	
Pedagogy:	Lectures/assignments/workshops/ street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations	
References/Readings	Module 1 and Module 2: 1. Chapman, J. L., &Reiss, M. J.(1999). *Ecology: Principles and applications*.Cambridge University Press. 2. Conklin, A.R.(2004).*Field sampling: Principles and practices in environmentalanalysis*.CRC Press. 3. Fahey, T.J., &Knapp, A.K.(2007).*Principles and standardsfor measuringprimaryproduction*.Oxford University Press. 4. Grant, W.E., &Swannack, T.M.(2008).*Ecological Modelling, Blackwell*. 5. Odum, E.P., &Barrett, G.W.(2004). *Basic ecology: Fundamentals of ecology*(5th ed).Oxford and IBH Publishing Co, Pvt. 6. Sutherland, W.J.(2006).*Ecological Census techniques a handbook*.Cambridge University Press. 7. Wilkinson, D. M.(2007).*Fundamental Processes in Ecology: An Earth system Approach*.Oxford University Press. 8. Garcia, S.L.(2019). Gender and water. *Gender CC—Women for climatejustice*. UN. 9. Lynn, H.(2018). Seeing red: Menstruation and the environment, #PLASTICFREEPERIODS. *Women's environment network: London*. 10. Kaur, R., Kaur, K., &Kaur, R.(2018). Menstrual hygienemanagement, and wastedisposal: Practice and challengesfaced by girls/women of developingcountries. *Journal of Environmental and Public Health*Feb 20; 2018:1730964. doi: 10.1155/2018/1730964. 11. Manisha, P.et al.(2009). *Human rights, gender and the environment*. Dorling Kinderseley.	
Learning Outcomes	1. Essential in depth understanding of the concepts and components of ecology. 2. Learners will learn ecosystem structure and function along with the interactions involved at various levels. 3. It would provide a vision to understand the ecosystem ecology along with sufficient knowledge of energy flow and exchange. 4. Sensitization of students towards the environment with respect to the global scenario and the related problems, impact, along with methods to tackle the problems.	

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Title of the Course:Climate Change

Course Code: ESC-22-202
Number of Credits: 03

Prerequisites for the course:	Basic understanding of the marine environment and microorganisms.	
Objective:	To introduce the students to climate change and also examine the methods and policies for the mitigation of climate change	
Content:	**Module 1: Introduction** Earth system, greenhouse gases: carbon dioxide, methane, nitrous oxide, warming potential, radiation and energy balance, solar variability, ozone and chlorofluorocarbon, aerosols, paleoclimate, ice-ages, carbon budget and global carbon cycle. **Module 2: Impact of climate change and future projections** Land and water resources, global warming, weather and heatwave, drought, biodiversity, extinction, migration, vegetation, agriculture and food security, human livelihood and health, ozone layer depletion, melting ice sheets, sea-level rise, precipitation. **Module 3: Ecological response** Floods, cyclone, changes in physical and biogeochemical properties of ocean: ocean acidification, deoxygenation, oxygen minimum zones, ocean circulation, effect on marine organisms, effect on polar regions, future projections and predictions: decadal, centennial, economic consequences. **Module 4: Mitigation and sustainability** Future Earth, adaptation, alternate energy sources: solar, wind energy, geothermal, biomass, biogas, hydrogen, lithium-ion battery, ocean thermal energy conversion, integrated assessment, emission budgets, future technologies: biofuels, hydrogen, geoengineering, carbon sequestration, contribution of oceans in mitigation, ethics and environmental policy, International agreements: United Nations Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement, role of India, youth and mass media in climate change mitigation.	06 hours 09 hours 15 hours 15 hours
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	1. Reichle, D. E.(2020). *The globalcarbon cycle and climateChange: Scalingecologicalenergetics from organism to biosphere*.Elsevier Science. 2. Johansen, B.E.(2017). *Climate Change: Anencyclopedia of science, society, and solutions*.ABC-CLIO. 3. Mélières, M. A., &Maréchal, C.(2015). *Climate Change: Past, present and future*.Wiley-Blackwell. 4. Hodgson, P. E.(2010). *Energy, the environment and climateChange*.Imperial College Press.	

	5. Laczko, F., &Aghazarm, C.(2009). *Migration, Environment and Climate Change: Assessing the evidence*.International Organization for Migration. 6. National Research Council.(2008). *Ecological impacts of climateChange*.National Academies Press. 7. Dessler, A.(2016). *Introduction tomodernclimateChange*(3rded).Cambridge University Press. 8. Srivastav, A.(2019). *The science and impact of climateChange*.Springer. 9. Chen, W. Y., Suzuki, T., &Lackner, M.(2012). *Handbook of climatechangemitigation and adaptation* (2nded).Springer.	
Learning Outcomes	1. Provides brief knowledge about climate change, its impact on all life forms and what measure can be taken to mitigate it. 2. It also highlights the role of youth in adopting a sustainable lifestyle to tackle this global issue.	

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Title of the Course:Environmental Geology
Course Code:ESC-22-203
Number of Credits: 03

Prerequisites for the course:	Bachelor's degree of this University or an examination of any other University recognised as equivalent.	
Objective:	1. To understand the rock and soil mechanics. 2. To study civil structures and their implications on the environment. 3. To impart knowledge about different slope failures as well as understand the remedial measures. 4. To gain knowledge on coastal processes and hazards.	
Content:	**Module 1: Introduction to rock and soil mechanics** • Engineering properties of the soil, soil profile, size of the soil particles; cohesion and alteration of clays. • Structure: Porosity, Voids ratio and degree of saturation. Plasticity and Atterberg limits, clay swelling and tests to determine. • Engineering properties of the rock: physical and mechanical properties, RQD, RMR. **Module 2: Civil structures and environment** • Dams: Earth dams, classification, causes of failure, introduction to stability analysis; Gravity dams, forces acting, classification, modes of failure, factors of safety and stability analysis. Reservoir induced seismicity and case studies. • Tunnels and bridges: Design and construction, identifying and managing geologic hazards - groundwater,	06 hours 09 hours

	problematic ground conditions, impacts to existing utilities and adjacent structures. • Nuclear plants: Construction, nuclear reactor accidents and safety. Case study. **Module 3: Landslides and their mitigation** • Introduction, Landslide classification, Natural landslides in soils and rocks. Types and modes of slope failure. Stability of slopes. Classification in slope stability evaluation. Remedial measures for stabilizing slopes. Monitoring and control. **Module 4: Coastal processes** • Waves, beach form and processes, transport and deposition of sediment, rip currents, coastal erosion, and erosional factors. Sea level changes. Coastal hazards and Stabilization: soft stabilization, hard stabilization and managed retreat; human activity and coastal erosion.	15 hours 15 hours
Pedagogy:	Lectures, case studies, discussions and assignments.	
References/ Readings	1. Keller, E.A. (2012). *Introduction to Environmental Geology* (5th ed). Prentice Hall. 2. Montgomery, C.W. (2010). *Environmental geology* (9th ed). Professor Emerita, Northern Illinois University. 3. Montgomery, C.W. (2020). *Environmental geology.* (11th ed). Professor Emerita, Northern Illinois University. 4. Bodansky, D. (2007). *Nuclear energy: principles, practices, and prospects.* Springer Science & Business Media. 5. Krynine, D.P., Judd, W.R., &Krynine, D. P. (1957). *Principles of engineering geology and geotechnics* (pp. 1-3). New York: McGraw-Hill. 6. Meiswinkel, R., Meyer, J., & Schnell, J. (2013). *Design and construction of nuclear power plants.* John Wiley & Sons.	
Learning Outcomes	In this course a student will learn about: 1. Concepts of engineering geology and basics of rock and soil mechanics. 2. Types of major civil structures and their impact on the environment. 3. Different types of landslides, their stabilization and control measures. 4. Various coastal processes, their hazards and mitigation.	

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Title of the Course: Basic Statistics
Course Code: ESC-22-204
Number of Credits: 03

Prerequisites for the course:	Completion of first semester of the programme	
Objective:	The aim of the course is to introduce students to the study of basic statistics so that they can independently explore data, analyse it and present it to academics, policy-makers and civil society.	
Content:	**Module 1: Introduction** Exploring Data: Basic concepts of descriptive statistics -- measures central tendency (mode, median and mean) and dispersion (range, interquartile range, variance and standard deviation). Displaying data. **Module 2:Correlation and regression** Bivariate analyses: Correlation, Measures of correlation: (Pearson's r). Scatter plots and Linear regression analysis. Goodness of fit (R-squared). **Module 3:Probability and distribution** Introduction to probability, random variables, concepts of events, sample space and random trials. Conditional probabilities, independence. Probability Distributions:Discrete probability distribution: Binomial and Poisson. Continuous probability distribution: Student-t, Normal, Standard Normal, Chi-square and F-distributions. **Module 4:Sampling distributions and inferential statistics** Sampling methods: Random, stratified random, non-random sampling methods. Determining sample size. Inferential statistics:Confidence interval; Testing of hypotheses: the null hypothesis and the alternative hypothesis.	06 hours 09 hours 15 hours 15 hours
Pedagogy:	Lectures/assignments/workshops/ street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations.	
References/Readings	1. Heumann, C., Schomaker, M., &Shalabh. (2016). *Introduction to statistics and dataanalysis: Withexercises, solutions and applications in R*. Cham, Switzerland: Springer. 2. Levine, S.D., Krehbiel, &Berenson. (2008). *Statistics for managers: UsingMicrosoft Excel* (5th ed). Pearson Education, Inc. 3. McClave, J.T., Benson, P.G., &Sincich, T.(2018). *Statistics for business and economics*. Pearson. 4. Witte, R.S., Witte, J.S.(2017). *Statistics* (11th ed). John Wiley & Sons, Inc.	
Learning Outcomes	1. The students will be able to understand the basic concepts in statistics. 2. They will learn how to collect, arrange, present and analyze data.	

Title of the Course: Environmental Management
Course Code: ESC-22-205
Number of Credits: 03

Prerequisites for the course:	Completion of first semester of the programme	
Objective:	The objective of the course is to enable participants to have a holistic understanding of the environment and know the methods of managing environmental issues.	
Content:	**Module 1: Introduction environmental management** Introduction to environmental management: Pollution and its various forms, Sustainability and sustainable development. **Module 2: Biodiversity and resources** Biodiversity and Resources: Societal ownership, Biodiversity, Benefits of natural resource protection, Traditional biodiversity knowledge, Bio-piracy. **Module 3: Environmental policies and management** Environmental policies and legislations and life cycle assessment: Environmental sustainability index, National and international environmental legislation, Life cycle assessment, LCA framework, Stages in LCA Energy Management and ISO Certification: Energy audits and methods, Energy conservation, Energy demand and balances, ISO 9000 and ISO 14000 series, Environment management certification. **Module 4: Pollution management** Water, air and noise pollution: Water pollution and management of water, Waste water and industrial waste water, Air pollution control measures. Noise pollution law and control measures. Solid waste and hazardous waste: Solid and hazardous waste sources and composition, Effect on health, storage, treatment and disposal of hazardous waste, Landfill designs, methods of disposal of solid waste. Monitoring environment using analytical methods: Statistical and instrumental methods, Analyses of all types of environmental pollution.	06 hours 09 hours 15 hours 15 hours
Pedagogy:	Lectures/tutorials/ laboratory work /field work/outreach activities/ project work/ vocational training/ viva /seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
References/ Readings	1. Murali Krishna, V., &Manickam, V. (2017).*Environmental Management*.Butterworth-Heinemann. 2. Kulkarni, V., &Ramchandra, T.V. (2009).*Environmental management, commonwealth of learning*.Indian Institute of Science.	
Learning Outcomes	At the end of the course the participant should be able to identify: 1. Environmental impact 2. Methods of control of such impacts 3. Analyse the impact using statistical and other analytical tools 4. Suggest specific interventions to alleviate environmental issues.	

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Title of the Course: Environmental Impact Assessment II
Course Code: ESC-22-206
Number of Credits: 01

Prerequisites for the course:	Completion of first semester of the programme	
Objective:	To understand the Environmental Impact Assessment processes through the study of EIA reports available for various kinds of projects.	
Content:	**Module 1:** Study of EIA reports for major projects of the country available online and understand the methods used, interpretations made, conclusions drawn, objections raised and decisions taken and their implementation.	15 hours
Pedagogy:	Lectures/tutorials/ laboratory work /field work/outreach activities/ project work/ vocational training/ viva /seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
References/ Readings	1. Yerramilli, A., &Manickam, V. (2020). *Environmental impactassessmentmethodologies* (3rded). BS Publications/British Society of Periodontology Books. 2. Glasson, J., &Therivel, R. (2019). *Introduction to environmentalimpactassessment* (5th Ed.). Routledge. 3. Khandeshwar, S.R., Raman N.S., &Gajbhiye, A.R. (2019). *Environmental Impact Assessment.* Dreamtech Press. EIA manuals available at: 1. http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel3.html 2. Sectoral Manuals under EIA Notification, 2006: 3. http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel2.html 4. Anonymous. Environmental Impact Assessment Training Manual. 2016. International Institute for Sustainable Development. 5. http://www.iisd.org/learning/eia/wp-content/uploads/2016/06/EIA-Manual.pdf 6. EIA Online Learning Platform www.iisd.org/learning/eia	
Learning Outcomes	After the discussion of case studies, the students will be able to understand how to work and write EIA reports for each of the major sectors.	

Title of the Course:Mineral resource management
Course Code: ESO-22-207
Number of Credits: 01

Prerequisites for the course:	Bachelor's degree of this University or an examination of any other University recognised as equivalent.	
Objective:	To understand the interaction of humans with the geological environment.	
Content:	**Module 1: Introduction** • Earth in space and time • Internal structure of the earth and Geological time scale **Module 2: Earth, its resources and the management** • Geological evolution of earth: plate tectonics and seafloor spreading • Mineral resources and reserves; UNFC. • Mining: surface and underground mining, mine ventilation, mine drainage, environmental effect of mining, environmentally sensitive green mining, mine closure. Trace elements and their implications on health.	02 hours 13 hours
Pedagogy:	Lectures, case studies, discussions and assignments.	
References/ Readings	1. Merrits. D., De Wet, A., &Menking, K. (1997). *Environmental Geology: an earth system science approach.* W. H. Freeman, New York. 2. Keller, E. A. (2012). *Introduction to Environmental Geology* (5th ed). Prentice Hall. 3. Montgomery, C. W. (2010). *Environmental geology*. (9th Ed.). Professor Emerita, Northern Illinois University. 4. Montgomery, C. W. (2020). *Environmental geology*. (11th ed). Professor Emerita, Northern Illinois University. 5. Pipkin, B. W., Trent, D. D., Hazlett, R., &Bierman, P. (2013). *Geology and the Environment*. Cengage Learning. 6. Valdiya, K. S. (1987). *Environmental geology, Indian context*. Tata McGraw-Hill Pub. Co.	
Learning Outcomes	In this course a student will learn about: 1. Concepts of environmental geology and its interaction with the human beings, 2. Management of geological resources.	

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Title of the Course: Pollution and Environment
Course Code: ESO-22-208
Number of Credits: 01

Prerequisites for the course:	Bachelor's degree of this University or an examination of any other University recognised as equivalent.

Objective:	• To understand the interaction of humans with the geological environment. • To study pollutants in the environment and to find the suitable remedial measures to cover harmful effects.	
Content:	**Module 1: Introduction** • Human and geological environment **Module 2: Types of pollution and remedial measures** • Hydrology and pollution – Impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; remedial measures. • Soil Science - Soil profile, soil types and their classification and formation; soil quality degradation, control measures Waste and its disposal - surface and subsurface disposal of toxic, metallic and radioactive wastes. Planning and management of hazardous waste. Domestic refuse and landfill.	02 hours 13 hours
Pedagogy:	Lectures, case studies, discussions and assignments.	
References/ Readings	1. Keller, E. A. (2012). *Introduction to Environmental Geology* (5th ed.). Prentice Hall. 2. Montgomery, C. W. (2010). *Environmental geology*. (9th Ed.). Professor Emerita, Northern Illinois University. 3. Montgomery, C. W. (2020). *Environmental geology*. (11th Ed.). Professor Emerita, Northern Illinois University. 4. Pipkin, B. W., Trent, D. D., Hazlett, R., &Bierman, P. (2013). *Geology and the Environment*. Cengage Learning. 5. Valdiya, K. S. (1987). *Environmental geology, Indian context*. Tata McGraw-Hill Pub. Co.	
Learning Outcomes	In this course a student will learn about: 1. Concepts of environmental geology and its interaction with the human beings, 2. Management of geological resources, 3. Appropriate use of the geological site for waste disposal.	

Title of the Course: Natural and manmade hazards
Course Code: ESO-22-209
Number of Credits: 01

Prerequisites for the course:	Bachelor's degree of this University or an examination of any other University recognised as equivalent.	
Objective:	1. To understand the interaction of humans with the geological environment. 2. To impart knowledge about different natural as well as manmade hazards with deterrent measures.	
Content:	**Module 1 : Introduction** • Life on Earth	02 hours

	Module 2 : Geological hazards Assessing geological hazards and risks: Earthquakes, volcanic eruptions, floods and droughts, mass movement-landslides, rock fall, preventive and mitigation measures.	13 hours
Pedagogy:	Lectures, case studies, discussions and assignments.	
References/ Readings	1. Keller, E. A. (2012). *Introduction to Environmental Geology* (5thed). Prentice Hall. 2. Montgomery, C. W. (2010). *Environmental geology*. (9thed). Professor Emerita, Northern Illinois University. 3. Montgomery, C. W. (2020). *Environmental geology*. (11thed). Professor Emerita, Northern Illinois University. 4. Pipkin, B.W., Trent, D.D., Hazlett, R., &Bierman, P. (2013). *Geology and the Environment*. Cengage Learning. 5. Valdiya, K.S. (1987). *Environmental geology, Indian context*. Tata McGraw-Hill Pub. Co. 6. Valdiya, K. S. (2013). *Environmental Geology: Ecology, Resource and Hazard Management*. McGraw-Hill Education.	
Learning Outcomes	In this course a student will learn about recognition of natural hazards and mitigation.	

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Title of the Course: Marine Habitat conservation and Restoration
Course Code: ESO-22-210
Number of Credits: 01

Prerequisites for the course:	Bachelor's degree of this University or an Examination of any other University recognised as equivalent.	
Objective:	To create awareness regarding habitat degradation, monitoring and strategies for restoration with specific reference to coastal habitats.	
Content:	**Module 1 : Introduction** Introduction to restoration, importance, types, concepts and principles **Module 2 : Habitat monitoring and restoration** Habitat degradation, Human interference and anthropogenic inputs, tourism effect, damaged ecosystems, fragmentation Marine Protected areas, restoration ecology and global framework, Coral reef damage, bleaching, restoration, Seagrass beds, restoration initiatives at GBR and India, Cost-benefit analysis of restoration, ecosystem development and restoration program design, Monitoring and evaluation - adaptive management, the purpose and importance of monitoring and evaluation, and feedback mechanisms to improve the management of the restoration process.	03 hours 12 hours
Pedagogy:	Lectures, case studies, discussions and assignments.	

References/ Readings	1. Andrew, W. (2013). *Handbook of environmental degradation of materials* (3rded). Elsevier, Amsterdam, Netherlands. 2. Kellert**, S.R. (1996).** ***The Value of Life: Biological Diversity and Human Society***.Island Press, Washington, DC. 3. Hawksworth, D.L. (2020). Books on biodiversity and conservation. Biodiversity and Conservation. *29*, 3843–3862. 4. Perrow, M.R., Davy, A.J. (Eds.). (2009). *Handbook of ecological restoration*, *Volume 1: Principles of Restoration.* Cambridge University Press.	
Learning Outcomes	Ability to identify the potential areas likely to be subjected for degradation and to evolve with appropriate remedies for conservation and restoration	

Title of the Course: Ecological significance of symbiosis
Course Code: ESO-22-211
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline with science subjects at 10+2 level.	
Objective:	1. To describe the diversity of symbiotic associations in the environment. 2. To understand the nuances of symbiotic interactions, their multifaceted nature, relevance and role in evolution.	
Content:	**Module 1: Introduction** • Concept of symbiosis. • Diversity of microbial symbiotic associations: Concept of rhizosphere, mycorrhizosphere, phycosphere, satellite bacteria, microbiome. **Module 2: Intricacies, molecular evolution and ecological significance of symbiosis** • Multipartner symbiotic systems:the multifaceted and dynamic nature of symbiotic interactions; establishment and maintenance of symbiotic associations, vertical versus horizontal transmission of symbionts; quorum sensing; mixotrophy, kleptoplastidy. • Influence of symbiotic interactions on Circadian rhythms and gene expression; holobiont concept, the hologenome theory of evolution and the role of microorganisms in speciation; endosymbiotic theory for the origin of eukaryotic organelles.	03 hours 12 hours
Pedagogy:	Lectures/ case studies/ tutorials/ videos/ assignments/ self-study	
References/ Readings	1. Duplouy, A., Dotson, B. R., Nishiguchi, M. K., & Cárdenas, C. A. (2021). Symbiosis in a Changing Environment. *Frontiers in*	

	Ecology and Evolution, 536, https://doi.org/10.3389/fevo.2021.731892. 2. Lipnicki, L. I. (2015). The role of symbiosis in the transition of some eukaryotes from aquatic to terrestrial environments. *Symbiosis,* 65(2), 39-53. 3. Munn, C. B. (2011). *Marine microbiology: ecology & applications*. CRC Press. 4. Hawksworth, D. L., &Grube, M. (2020). Lichens redefined as complex ecosystems. *The New Phytologist*, *227*(5), 1281-1283. 5. Pacheco, A. R., &Segrè, D. (2019). A multidimensional perspective on microbial interactions. *FEMS Microbiology Letters*, *366*(11), fnz125. 6. Heath-Heckman, E. A. (2016). The metronome of symbiosis: interactions between microbes and the host circadian clock. *Integrative and Comparative Biology.* 56(5), 776-783. 7. Lee, S. J., Morse, D., &Hijri, M. (2019). Holobiont chronobiology: mycorrhiza may be a key to linking aboveground and underground rhythms. *Mycorrhiza*, *29*(5), 403-412. 8. Rosenberg, E., &Zilber-Rosenberg, I. (2018). The hologenome concept of evolution after 10 years. *Microbiome*, *6*(1), 1-14.	
Learning Outcomes	Students will appreciate the ubiquity and relevance of symbiotic associations in the environment, and their diverse roles, including in evolution.	

Title of the Course: Nitrogenand Climate Change
Course Code: ESO-22-212
Number of Credits: 01

Prerequisites for the course:	Graduate in any discipline with science subjects at 10+2 level.	
Objective:	To enable students to understand: 1. Nitrogen (N) cycling in the marine environment. 2. Factors responsible for causing pertubations in biogeochemical cycling of the element. 3. Impact of oceanic production of the greenhouse gas nitrous oxide (N_2O) on the climate.	
Content:	**Module 1: Introduction** Nitrogen (N) species in the marine environment; Primary routes for entry of N into the marine environment; Spatial and seasonal distribution of dissolved nitrogen compounds in seawater. **Module 2: Nitrogen transformations in the marine environment and its impact on the climate** Biogeochemical cycling of N; Controlling factors; analytical methods for the study of N compounds; Disruptions caused to marine N cycle due to seawater stratification and upwelling;	03 hours 12 hours

	Impact of agricultural activities, fossil fuel burning and aquaculture; Nitrous oxide as a driver of climate change, Influence of warming, deoxygenation and acidification on oceanic N_2O cycling and emissions to the atmosphere, Mitigation strategies for excess N in aquatic systems.	
Pedagogy:	Lectures/ case studies/ tutorials/ videos/ assignments/ self-study	
References/ Readings	1. Bonaglia, S. (2015). Control factors of the marine nitrogen cycle : The role of meiofauna, macrofauna, oxygen and aggregates (PhD dissertation, Department of Geological Sciences, Stockholm University). 2. Capone, D.G., Bronk, D.A., Mulholland, M.R., & Carpenter, E.J. (Eds.) (2008). *Nitrogen in the marine environment* (2nd ed). Academic Press. 3. Capone, D.G., & Hutchins, D.A. (2013). Microbial biogeochemistry of coastal upwelling regimes in a changing ocean. *Nature Geoscience*, *6,* 711-717. 4. Fowler, D., Coyle, M., Skiba, U., Sutton, M. A., Cape, J.N., Reis, S., Sheppard, L.J., Jenkins, A., Grizzetti, B., Galloway, J. N., Vitousek, P., Leach, A., Bouwman, A.F., Butterbach-Bahl, K., Dentener, F., Stevenson, D., Amann, M., & Voss, M. (2013). The global nitrogen cycle in the twenty-first century. *Philosophical Transactions of the Royal Society B*: *Biological Sciences*, *368,* 1621. 5. Hutchins, D.A., & Capone, D.G. (2022). The marine nitrogen cycle: new developments and global change. *Nature Reviews Microbiology.*https://doi.org/10.1038/s41579-022-00687-z. Epub ahead of print. PMID: 35132241. 6. McCarthy, M.D., &Bronk, D.A. (2008). **Analytical methods for the study of nitrogen. In:**D.G. Capone, D.A. Bronk, M.R. Mulholland, E.J. Carpenter (Eds.). *Nitrogen in the Marine Environment* (2nd ed.), (pp. 1219-1275) Academic Press. 7. Reay, D. (2015). *Nitrogen and Climate Change: an Explosive Story* (pp. 193–205). Palgrave Macmillan, UK, London. 8. Voss, M., Baker, A., Bange, H., Conley, D., Cornell, S., Deutsch, B. et al. (2011). Nitrogen processes in coastal and marine ecosystems. In: M. Sutton, C. Howard, J. Erisman, G. Billen, A. Bleeker, P. Grennfelt, et al. (Eds.), *The European Nitrogen Assessment: Sources, Effects and Policy Perspectives* (pp. 147-176). Cambridge University Press. 9. Voss, M., Bange, H.W., Dippner, J.W., Middelburg, J.J., Montoya, J.P., & Ward, B. (2013). The marine nitrogen cycle: recent discoveries, uncertainties and the potential relevance of climate change. *Philosophical Transactions of the Royal Society B*: *Biological Sciences*, 368, 20130121. 10. Zehr, J.P., &Kudela, R.M. (2011). Nitrogen Cycle of the Open Ocean: From Genes to Ecosystems. *Annual Review of Marine Science*, *3*, 197-225.	

Learning Outcomes	This course will enable students to: 1. Predict human impacts on nitrogen biogeochemistry in aquatic systems. 2. Suggest and/or initiate mitigation measures to counter excessive nutrient input in coastal waters.	

Title of the Course: Environment and Literature
Course Code: ESO-22-213
Number of Credits: 02

Prerequisites for the course:	Bachelor's degree in any discipline	
Objectives:	1. To highlight the symbiotic relationship between environment and literature beginning from the Vedic times. 2. To focus on the preoccupation of modern writers with issues related to environmental degradation, consumerist culture etc. 3. To encourage the students to adopt an interdisciplinary perspective while dealing with the large spectrum of issues pertaining to environment and literature. 4. To drive home the idea that questions related to aesthetics cannot be divorced from ethics.	
Content:	**Module 1:Introduction** Tracing the Trajectory of Environmental Concerns in Indian & Western Literature: Moments & Movements **Module 2:Paradigms & Categories** Romanticism Martin Heidegger on Technology Ecocriticism Ecofeminism Environmental Humanities Externality Deep Ecology **Module 3:Indian Perspective** *The Upheaval* by PundalikNaik (Novel) **Module 4:Western Perspective** *The Road* by Cormac McCarthy (Novel)	04 hours 08 hours 09 hours 09 hours
Pedagogy:	Lectures/tutorials/assignments/seminars.	
References/ Readings:	1. Bellamy P. (2007). *Dictionary of Environment* (3rd ed) New Delhi, Academic (India) Publishers.. 2. Blanning, T.C.W. (2010). *The Romantic Revolution*, George Weidenfield& Nicholson Publishers. *3.* Broswimmer, F.(2002). *Ecocide: A Short History of Mass Extinction of Species* Pluto Press Publishers.	

	4. Buell, L. 1998. *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture*. Cambridge: Harvard University Press. 5. Garrard, G. (2004). *Ecocriticism: The New Critical Idiom* Oxford, Blackwell. 6. McCarthy, C. (2006). *The Road*, London, Pan Macmillan. 7. Vacoch, D.A.& Mickey, S. (Eds.) (2018). *Literature and Ecofeminism: Intersectional and International Voices*(1st ed). Routledge, London. 8. Naik, P.N. (2002). *The Upheaval*. Translated by V.Pai, Oxford University Press, New York.	
Learning Outcomes	1. Understand the relationship between literature and environment. 2. Appreciate and recognise the aesthetic as well as the ethical dimensions of literature. 3. Make an independent analysis of literary texts in the context of issues related to environment.	

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Title of the Course:Gender Sensitivity and Equity
Course Code: ESO-22-214
Number of Credits: 02

Prerequisites for the course:	Student should be registered with Goa University Post Graduate Programme	
Objective:	This course aims to develop the basic understanding of gender related issues in the society among students with multidisciplinary approach.	
Content:	**Module 1: Introduction** The universal commitment to Gender Equality and Social Equity – SDGs, Provisions in the Indian Constitution, Towards Equality Report and the creation of the discipline of Women's Studies in India. Sex and Gender: Non-duality of these terms. Nature vs Nurture debate, socialisation, stereotyping. **Module 2: Social Equity** Power, Intersectionality. Marginalised sections based on caste, class, abilities, religion etc. Women's rights as human rights. Women's issues in Goa. **Module 3: Introduction to Laws** Sexual Harassment at Work Place (Protection, Prohibition, and Redressal Act of 2013) and Protection of Women from Domestic Violence Act of 2005. Forms of violence against women: a review.	10 hours 10 hours 10 hours
Pedagogy:	This course will be taught through workshops/ lectures/ group discussions/assignment/quiz games/ tutorials/ assignments/ films/ documentaries/ group	

References/Readings	1. Government of India. (2005). DV Act 2005 http://ncw.nic.in/acts/TheProtectionofWomenfromDomesticViolence Act2005.pdf 2. Government of India, (2013). Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act of 2013.http://www.iitbbs.ac.in/notice/sexual-harrassment-ofwomen-act-and-rules-2013.pdf 3. Pilcher J., &Whelehan, I. (2005). *50 Key Concepts in Gender Studies.*Sage Publications, New Delhi. 4. UNDP (2014). Women's Rights are Human Rights. file:///C:/Users/admin/Desktop/WomenRightsAreHR.pdf	
Learning Outcomes	1. Students will be enabled to develop the sensitive approach towards gender issues. 2. Students will have an understanding of equity, its importance in our society.	

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