GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

M I N U T E S

of the 3rd Meeting (Special) of the

X ACADEMIC COUNCIL

Day & Date

1st March, 2021

Time

10.30 a.m.

Online Via Google Meet

	To be eligible for admission to Semester III of the MCA Degree Programme, students are required to obtain a minimum of 40% marks separately in the Theory and Laboratory Component of the Bridge Course Assessment, which will be conducted by the faculty of the MCA Programme, Goa Business School. The marks obtained in the Bridge Course shall be shown on the final year grade sheet but shall not be considered for the computation of the SPI/CPI. The Chairperson (Vice-Chancellor) appreciated the efforts put in by the Chairperson and members of the Board of Studies for taking initiative and coming up with a two years Course. Pending finalization of the minutes, it was resolved to place the proposed Ordinance before the Drafting and Vetting Committee and thereafter before the Executive Council scheduled on 12th March, 2021. **(Action: Assistant Registrar Academic – PG)**
D 3.2	**Minutes of the Meeting of the Board of Studies in Political Science held by circulation on 23.02.2021 recommending to consider the proposed online Electoral Literacy Course developed jointly by the Department of Political Science and the Chief Electoral Office, Goa.** The Academic Council approved the minutes of the meeting of the Board of Studies in Political Science held by circulation on 23.02.2021 recommending the proposed online Electoral Literacy Course developed jointly by Department of Political Science and Chief Electoral Office, Goa with the following observations: 1. SVEEP (Systematic Voter Education and Enrolment Programme) activities to be included. 2. Board of Studies was requested to design another Course for the Undergraduate level. 3. Practical to be added for Unit 4 and Unit 5. Pending finalization of the minutes, it was resolved to place the minutes before the Executive Council scheduled on 12th March, 2021 for consideration. **(Action: Assistant Registrar Academic – PG)**
D 3.3	**Minutes of the meeting of the Board of Studies in Environmental Science held on 25.02.2021 recommending to consider the proposed structure and syllabus of the M.Sc./M.A. in Environment Science Programme.** The Academic Council approved the minutes of the meeting of the Board of Studies in Environmental Science held on 25.02.2021 recommending the proposed structure and syllabus of the M.Sc./M.A. in Environment Science Programme with the following observations: 1. Proposed new Ordinance to be corrected as OB-XX instead of OA-XX. 2. The structure of the Programme and the Courses for the entire two years (four semesters) were approved. 3. The Dissertation (Course ESC 409) to be made a Compulsory Component.

	4. Learning outcomes for Course ESC 202 to be redrafted. 5. The syllabi of Compulsory Courses for Semester I and Semester II were approved. 6. The entire clause OB XX.4 (iv) under Programme Structure to be deleted. 7. Course Structure to be deleted from the Ordinance. Pending finalization of the minutes, it was resolved to place the Ordinance before the Drafting and Vetting Committee and thereafter before the Executive Council scheduled on 12th March, 2021. **(Action: Assistant Registrar Academic – PG)**
D 7	**OTHER ITEMS**
D 7.1	**To discuss the Report of the Committee constituted under Statute SC-15.33 to assess the success of Autonomous Colleges in Goa.** Prof. K. R. S. Priolkar, Chairperson of the Committee presented the Report. After discussion, the Academic Council approved the Report of the Committee constituted under Statute SC-15.33 to assess the success of Autonomous Colleges in Goa with the following observations: 1. Point 3 of the conditions, 'new Courses' to be replaced with new academic Programmes. 2. During the period of autonomy, the College started eleven new programmes which are shown in the chart. The chart may be re-examined as some programmes are already discontinued. 3. The data on SCOPUS publications during 2015-2020 may be updated and a complete data of SCOPUS publications from affiliated institutions of Goa University may also be included as Annexure. Pending finalization of the minutes, it was resolved to place the Report of the Committee before the Executive Council scheduled on 12th March, 2021. **(Action: Assistant Registrar Academic - General)**

The meeting ended with thanks to the Chair.

Sd/-
(Prof. Radhika S. Nayak)
Registrar and Member Secretary

Date: 10.03.2021

Sd/-
(Prof. Varun Sahni)
Vice-Chancellor

X AC- 3 (Special)
01-03-2021

GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

A G E N D A

For the 3rd Special Meeting of the

X ACADEMIC COUNCIL

Day & Date

1st March, 2021

Time

10.30 a.m.

Online Via Google Meet

	The remarks of the Dean of 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:24-02-2021 Place: Goa University Sd/- Signature of the Dean (Back to Index)
D 3.3	**Minutes of the meeting of the Board of Studies in Environmental Science held on 25.02.2021.** **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: NIL **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.** Important points for consideration/approval of Academic Council i. The important points/recommendations of BoS that require consideration/approval of Academic Council (points to be highlighted) as mentioned below: a) BoS in Environmental science has approved the structure of the entire two year

	programmes of M.A. and M.Sc. and the entire syllabi of first two semesters (first year) is attached as **Annexure I** **(refer page no 32)**. b) The members suggested to have a uniformity across all the courses while assigning modules. The suggestion was to have four modules for each course with module 1 covering the introduction to the course and three more modules with appropriate credits. The revised syllabi have been approved after incorporating the suggestions made by the BoS members. ii. The declaration by the Chairperson that the minutes were readout by the Chairperson at the meeting itself. Date:25.02.2021 Place:Goa University Sd/- 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. The proposed new Ordinance OA-XX relating to the M.A./M.Sc. Programme is placed for consideration of the Academic Council as **Annexure II** **(refer page no 54)**. Date: Sd/- Place: Signature of the Dean **(Back to Index)**
D 7	**OTHER ITEMS**
D 7.1	**To discuss the Report of the Committee constituted to assess the success of the Autonomous Colleges in Goa, specifically with respect to the Parvatibai Chowgule College of Arts & Science, Margao Goa.** Based on the recommendation of the Executive Council in its meeting held on 26th April, 2019 a Committee was constituted vide Order No. GU/81/Acad.Gen/Autonomous College/33/705 dated 9/9/2020 under the Chairpersonship of Prof. K. R. S. Priolkar, to assess the Success of the Autonomous Colleges in Goa, specifically with respect to the Parvatibai Chowgule College of Arts & science, Gogol-Margao Goa. The Report of the Committee is placed as **Annexure I** **(refer page no 59)** for the consideration of the Academic Council. The Academic Council may kindly consider. **(Back to Index)**

D 3.3 Minutes of the meeting of the Board of Studies in Environmental Science held on 25.02.2021.

Annexure I

Syllabus

M.A. / M.Sc. in

Environmental Science

Goa University, Goa.

Why a programme in Environmental Science

Environmental science has conventionally studied physical, chemical and biological processes in the Earth system (Lithosphere, hydrosphere, atmosphere 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.

Entry requirements for M.A. Environmental Science degree

Graduate in any discipline including Medicine and B.Tech.

Entry requirements for M.Sc Environmental Science degree

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

Course structure and assessment methods

M.A/MSc in Environmental Science is a two years programme. The initial stages (first two semesters) of a student's study include compulsory core 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 options from a selection of possible course modules, allowing for growing specialization. Towards the end of the program, one is likely to have the opportunity to carry out own 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

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Programme - Core Courses

Sr. no.	Course code	Course title	No. of credits	L – P - T		
1	ESC-101	Environmental issues and perspectives	3	3	0	0
2	ESC-102	Fundamentals of economics	3	3	0	0
3	ESC-103	Environmental ethics	3	3	0	0
4	ESC-104	Ecosystems and biodiversity	3	3	0	0
5	ESC-105	Land, ocean and atmospheric interactions	3	3	0	0
6	ESC-106	Environmental impact assessment I	1	1	0	0
7	ESC-201	Ecology and society	3	3	0	0
8	ESC-202	Climate change and sustainability	3	3	0	0
9	ESC-203	Geoinformatics	3	3	0	0
10	ESC-204	Statistics	3	3	0	0
11	ESC-205	Environmental management	3	3	0	0
12	ESC-206	Environmental impact assessment II	1	1	0	0
13	ESC-301	Environmental Impact Assessment III	3	3	0	0
14	ESC-401	Environmental Impact Assessment IV	3	3	0	0
15	ESC-409	EIA Dissertation	8	0	8	0

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Programme - Optional Courses

Sr. no.	Course code	Course title	No. of credits	L – P - T		
1	ESO-301	Environmental Chemistry	3	2	1	0
2	ESO-302	Environmental politics	2	2	0	0
3	ESO-303	Sustainability Science	3	3	0	0
4	ESO-304	Environmental economics	3	3	0	0
5	ESO-305	Environmental history	2	2	0	0
6	ESO-306	Gender and Environment	3	3	0	0
7	ESO-307	Green Chemistry	3	3	0	0
8	ESO-308	Environmental geology	3	3	0	0
9	ESO-309	Marine Pollution	3	3	0	0
10	ESO-310	Conservation Biology	3	2	1	0
11	ESO-311	Environmental Microbiology	3	2	1	0
12	ESO-312	Ecotoxicology	3	3	0	0
13	ESO-313	Environmental Biotechnology	3	3	0	0
14	ESO-314	Environmental Security	3	3	0	0
15	ESO-315	Global Environmental Governance	3	3	0	0
16	ESO-316	Water Resource Management	3	3	0	0
17	ESO-401	Disaster Management	3	3	0	0
18	ESO-402	Energy and Environment	3	3	0	0
19	ESO-403	Solid and Hazardous Waste Management	2	2	0	0
20	ESO-404	Environmental Policy and Administration	3	3	0	0
21	ESO-405	Environmental Law	3	3	0	0
22	ESO-406	Environment, Livelihood and Marginalised Communities	3	3	0	0
23	ESO-407	Environmental History of India	2	2	0	0
24	ESO-408	Marine Biodiversity & Conservation Practices	3	3	0	0
25	ESO-409	Polar Studies	3	3	0	0
26	ESO-410	Environmental Geography	3	3	0	0

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Programme Structure
Semester - 1

Sr. no.	Course code	Course title	No. of credits	Lead School/Depts.	Collaborating Depts/School
1	ESC-101	Environmental issues and perspectives	3	Socio	SEOAS
2	ESC-102	Fundamentals of economics	3	GBS (EC)	
3	ESC-103	Environmental ethics	3	Philosophy	
4	ESC-104	Ecosystems and biodiversity	3	Botany	
5	ESC-105	Land, ocean and atmospheric interactions	3	SEOAS	
6	ESC-106	Environmental impact assessment I	1	Zoology	

Total 16 credits

Semester - II

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-201	Ecology and society	3	Zoology	MPS, Sociology
8	ESC-202	Climate change and sustainability	3	SEOAS	Zoology, Botany, GBS
9	ESC-203	Geoinformatics	3	SEOAS	
10	ESC-204	Statistics	3	GSB	
11	ESC-205	Environmental management	3	GBS	
12	ESC-206	Environmental impact assessment II	1	Botany	

Total 16 credits

Semester - III

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-301	Environmental Impact Assessment - III	3	SEOAS	
8	ESC-302	Optional Course - 1	3		
9	ESC-303	Optional Course - 2	3		
10	ESC-304	Optional Course - 3	3		
11	ESC-305	Optional Course - 4	2		
12	ESC-306	Optional Course - 5	2		

Total 16 credits

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Semester - IV

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-401	Environmental Impact Assessment IV	3	SEOAS	
8	ESC-402	Optional - 6	3		
9	ESC-403	Optional - 7	2		
10	ESC-409	EIA Dissertation	8		
		Total	16 credits		

Detailed Syllabus
M.A. / M.Sc. in Environmental Science

Title of the Course: Environmental Issues and Perspectives
Course Code: ESC-101 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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 all 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 Interdisciplinary and multidisciplinary approaches to environment and major themes – biological, ecological and social ecological orientations	10 hours
	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.	08 hours
	Module 3: Environmental issues and concerns Environmental conservation, Food and agriculture Environmental health, pollution and toxicology Climate and global warming Solid and hazardous waste	08 hours
	Module 4: Social issues and environment Urban growth and industrial planning Development, displacement and rehabilitation Ideologies of environmentalism Towards articulating sustainable environmental future	10 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and	

	discussion/ presentations	
References/Readings	1. Basu, Mahua and Xavier S. 2016. *Fundamentals of Environmental Studies.* New Delhi: Cambridge University Press. 2. Carolyn, Merchant (Ed.). 1996. *Ecology*. Jaipur: Rawat Publications. 3. Gadgil, Madhav and Guha, Ramachandra. 2000.*Use and Abuse of Nature.* New Delhi: Oxford University Press. 4. Gadgil, Madhav and Guha, Ramachandra. 1995. *Ecology and Equity.* New Delhi: Oxford University Press. 5. Guha, Ramchandra. 2000. *Environmentalism: A Global History.* New York: Oxford University Press. 6. Joseph, Benny. 2009. *Environmental Studies (Second Edition).* New Delhi: Tata McGraw Hill. 7. Krishna, Sumi. 1996. *Environmental Politics.* New Delhi: Sage Publications. 8. Rangarajan, Mahesh. 2007 (Ed.). *Environmental issues in India: A Reader.* India: 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-102 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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.	04 hours 10 hours 10 hours

	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.	12 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations	
References/Readings	1. Dasgupta, Partha (2007) Economics: A Very Short Introduction; (2007), Oxford 2. Mankiw, G., (2018). Principles of Economics, 8th Edition, Boston: Cengage Learning. 3. Samuelson, Paul A. & William D. Nordhaus (2019) Economics, McGraw Hill 4. Duflo, Esther & Abhijit Banerjee (2019) Good Economics for Hard Times : Better Answers to Our Biggest Problems, Hachette Books	
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-103 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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.	06 hours 15 hours 15 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations	

References/Readings	1. John Passmore, Man's Responsibility for Nature, New York: Charles Scribner's son, 1974. 2. Robin Attfield, *Environmental Philosophy*, Cambridge: Polity Press, 2014. 3. Paul W. Taylor, *Respect for Nature: A Theory of Environmental Ethics*, Princeton, Princeton University Press, 1986. 4. John. A. Grim (edt.), *Indigenous Traditions and Ecology- The Inter-being of Cosmology and Community*, Harvard University Press, 2001. 5. Dale Jamieson, *Ethics and Environment- An Introduction,* New York, Cambridge University Press, 2008. 6. Ronald Sandler, *Environmental Ethics: Theory in Practice*, USA, Oxford University Press, 2017. 7. Helen Kopnina, Haydn Washington, Bron Taylor & John J Piccolo, ''Anthropocentrism: More than Just a Misunderstood Problem'', *Journal of Agricultural and Environmental Ethics volume 31*, 2018. 8. Francois Jaquet, ''Is Speciesism Wrong by Definition?'', *Journal of Agricultural and Environmental Ethics volume 32, (3),* 2019.	
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.	

Title of the Course: Ecosystems and Biodiversity
Course Code: ESC-104 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

Prerequisite for the course:	There is no prerequisite for this course apart from the program requirements	
Course objectives:	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: Introdcution** Ecosystems - Development of concept and the current understanding; Ecosystem as a system. Structural and Functional components of	9 hours

	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 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** Biogeographical 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.	9 hours 6 hours 6 hours 6 hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations.	
References/ Readings	1. Chapman, J. L. & M. J. Reiss (1999). Ecology: Principles and Applications, Second edition. Cambridge University Press. ISBN: 0521588022, 9780521588027 2. Kormondy, Edward J. (2017) Concepts of Ecology, 4th Edition. Pearson. ISBN-10: 9332586098; ISBN-13: 978-9332586093 3. Singh J.S., Singh S.P. & Gupta S.R. (2014). Ecology, Environmental Science & Conservation. S. Chand Publishing. ISBN: 9383746009, 9789383746002 4. Begon, M., Howarth, R.W. & C.R. Townsend (2014). Essentials of	

	Ecology, 4th Edition. ISBN: 1118802373, 9781118802373 5. Bowman, William D., Hacker, Sally D. & Michael L. Cain (2020). Ecology, Fifth Edition. Oxford University Press, Incorporated. ISBN: 160535922X, 9781605359229 6. Chapin III, S.F., P. A. Matson & P. Vitousek (2011). Principles of Terrestrial Ecosystem Ecology, Second Edition. Springer. ISBN: 1441995048, 9781441995049 7. Gaston, Kevin J. & John I. Spicer (2004) Biodiversity: An Introduction, 2nd Edition. Blackwell Science. ISBN: 978-1-405-11857-6 8. Gaston, Kevin J. (Ed.) (1996) Biodiversity: A biology of numbers and difference. Blackwell Science. ISBN: 978-0865428041, 0865428042 9. Groombridge, Brian & Martin D. Jenkins (2002). World Atlas of Biodiversity: Earth's Living Resources in the 21st Century. University of California Press. ISBN: 0520236688, 9780520236684 10. Henderson, Peter A. & T. R. E. Southwood (2016), Ecological Methods, 4th edition. John Wiley & Sons. ISBN:1118895282, 9781118895283 11. Jørgensen, S., L. Xu & R. Costanza (2016). Handbook of Ecological Indicators for Assessment of Ecosystem Health, Second edition. CRC Press. ISBN: 1439809372, 9781439809372 12. Jorgensen, Sven Erik (Ed.) (2009) Ecosystem Ecology. Elsevier. ISBN: 0444534660, 9780444534668 13. Krebs, Charles J. (2013). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition. Pearson. ISBN: 1292026278, 9781292026275 14. Raffaelli, David G. & Christopher L. J. Frid (Eds.) (2010). Ecosystem Ecology: A New Synthesis. Cambridge University Press. ISBN: 1139486144, 9781139486149 15. Smith, T.M. & R.L. Smith (). Elements of Ecology, Ninth Edition. Person. ISBN: 1292077409, 9781292077406 16. Wilson, E.O. (Ed.) (1988). Biodiversity. National Academy Press. 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-105 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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 fresh water - distribution of temperature, salinity, density and oxygen in space and time	6 hours
	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.	10 hours
	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.	10 hours
	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.	10 hours
Pedagogy:	Use of conventional, online and ICT Methods. Lecture/Tutorials/Assignments	
References/ Readings	1. Wallace, J. M., and P. V. Hobbs, Atmospheric Science: An Introductory Survey, 2nd edition, Elsevier Academic Press, 2006. 2. Marshall J., and R. A. Plumb, Atmosphere Ocean and Climate Dynamics: An Introductory Text, Elsevier Academic Press, 2008. 3. Hess, L. S., Introduction to Theoretical Meteorology, Wiley Online Library. 4. Houghton, J. T., Physics of the Atmosphere, Cambridge University Press, 2002.	

	5. Stewart, R. L., Introduction to Physical Oceanography. 6. Waves, Tides and Shallow Water Processes: Open University Course Team and Butterworth- Heinemann Publications, Oxford, UK, 1999. 7. Williams, F. J., and S. Elder, Fluid Physics for Oceanographers and Physics: An introduction to incompressible, US Naval Academy, Paragon Press. 8. The Ocean: Their Physics, Chemistry and Biology, 1962 - Sverdrup, H.U., Johnson, M.W. and Flemming, R.H., Asia Publ. House, New Delhi. 9. Meller, C. B., Wheeler, P. A., Biological Oceanography, Wiley Blackwell Publishers. 10. Oceanography (5th ed), 1990 Grant Gross, M., Englewood Cliffs, N.J. Prentice Hall. 11. Introductory Oceanography (5th ed), 1988 Thurman, H.V., Columbus Mercill Publ. Co, Ohio. 12. Talley, L. D., G. L. Pickard, W. J. Emery and J. H. Swift, Descriptive Physical Oceanography, 6th edition, Elsevier, 2011. 13. Lenton, T., Earth System Science: A Very Short Introduction, 1st edition, Oxford University Press, 2016. 14. Ehlers, E., and T. Kraft, Earth System Science in the Anthropocene: Emerging Issues and Problems, Springer. 15. Jacobson, M. C., R. J. Charlson, H. Rodhe, and G. H. Orians, Earth System Science: From Biogeochemical Cycles to Global Changes, Elsevier Academic Press, 2006.	
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-106 **Number of Credits:** 01
Total Contact Hours: 12 **Effective from AY:** 2021-22

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** 1. **Introduction and principals:** Introduction; nature and purpose of EIA; Project, Environment and nature of Impacts; Changing perspective and current issues in EIA; EIA regulations.	12 hours

	2. **Starting up early stages:** Managing the EIA process; project screening, scoping; understanding the project/development action; establishing the environmental baseline; impact identification. 3. **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. 4. **Practice and prospects:** Legal Challenges, cost and benefits of EIA; Case studies of EIA in practice; strategic environmental assessment; extending EIA to project implementation.	
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 Environmental Impact Assessment. Published by Routledge. Taylor and Francis Group. New York 2. Arts, J., & Morrison-Saunders, A. (Eds.). (2012). *Assessing impact: handbook of EIA and SEA follow-up*. Routledge. Taylor and Francis Group. New York 3. Abaza, H., Bisset, R., Sadler, B., (2004). Environmental Impact Assessment and Strategic Environmental Assessment: towards an Integrated approach. UNEP. 4. Therivel, R., & Wood, G. (Eds.). (2017). *Methods of environmental and social impact assessment*. Routledge.Taylor and Francis Group. New York. 5. Morris, P., & Therivel, R. (Eds.). (2001). *Methods of environmental impact assessment* (Vol. 2). Taylor & Francis. New York	
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: Ecology and Society
Course Code: ESC-201 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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 Manohar Parrikar 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	6 hours 6 hours 12 hours 12 hours

	Goa - Kumeri cultivation, Social Ecology, Traditional knowledge, Power and Agency. 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 JL and Reiss MJ (1999), Ecology: Principles and Applications, Cambridge University Press. 2. Conklin AR (2004), Field Sampling: Principles and Practices in Environmental Analysis, CRC Press. 3. Fahey TJ and Knapp AK (2007), Principles and Standards for Measuring Primary Production, Oxford University Press, UK. 4. Grant WE and Swannack TM (2008), Ecological Modeling, Blackwell. 5. Odum EP and Barrett GW (2004), Basic Ecology: Fundamentals of Ecology, Fifth Edition, Oxford and IBH Publishing Co. Pvt. 6. Sutherland WJ (2006), Ecological Census techniques a handbook, Cambridge University Press. 7. Wilkinson DM (2007), Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK. Module 3: 1. Garcia, Sara Lopez. 2019. *Gender and Water*, Gender CC – Women for Climate Justice. UN: Berlin. 2. Helen Lynn. 2018. *Seeing Red: Menstruation and the Environment*, #PLASTICFREEPERIODS. Women's Environment Network: London. 3. Kaur Rajanbir et al, 2018. Menstrual Hygiene Management, and Waste Disposal: Practice and Challenges Faced by Girls/Women of Developing Countries, in *Journal of Environmental and Public Health* (Article ID 1730964). 4. Priyam Manisha et al. 2009. *Human Rights, Gender and the Environment*. Dorling Kinderseley: India.	
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.	

Title of the Course: Climate Change and Sustainability
Course Code: ESC-202 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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.	6 hours 10 hours 10 hrs 10 hours
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	1. Reichle D. E., The Global Carbon Cycle and Climate Change: Scaling Ecological Energetics from Organism to Biosphere, Elsevier, 2020. 2. Johansen B.E., Climate Change: An Encyclopedia of Science, Society, and Solutions, Volume 1, Land and Oceans, ABC-CLIO, LLC, 2017. 3. Marie-Antoinette Mélières and Chloé Maréchal, Climate Change:	

	Past, Present and Future, Wiley-Blackwell, 2015. 4. Hodgson P.E., Energy, the Environment and Climate Change, Imperial College Press, 2010. 5. Frank Laczko and Christine Aghazarm, Migration, Environment and Climate Change: Assessing the evidence, International Organization for Migration, 2009. 6. Ecological Impacts of Climate Change, The National Academies Press, 2001 7. Dessler A., Introduction to Modern Climate Change, Second Edition, Cambridge University Press, 2016. 8. Srivastav A., The Science and Impact of Climate Change, Springer, 2019. 9. Chen W. Y., Suzuki T., Lackner M., Handbook of Climate Change Mitigation and Adaptation, Second Edition, Springer, 2012.	
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 Geoinformatics
Course Code: ESC-203 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

Prerequisites for the course:	A compulsory course for students admitted to Environmental Science programme. Students for this course are expected to have experience of basic use of computers and concepts of geography & environment.	
Objective:	Students to gain important skills in spatial data acquisition, analysis and interpretation, lab and field methods of GIS and remote sensing.	
Content:	**Module 1: Introduction** Introduction, Geoinformatics for environmental monitoring and management; Introduction to photogrammetry; Geodata and geoinformatics (Geodata, Concept of digital earth, Geoinformatics Fundamentals). Geoinformatics-applications to Environmental monitoring and management. Geoinformatics for environmental decision making. **Module 2:** Image visualization, analyses and interpretation. Introduction to aerial photos, Satellite imageries, Concept of image, Resolution and scale. Module 3: Image visualization and digital image processing, Transformation	6 hours 10 hours 10 hours

	and classification; Hands on tutorials and related image processing exercises. **Module 3:** Fundamentals of Remote Sensing (Basic Concept, Principles of EM Radiation, EMR and EMR interaction with atmosphere, Passive versus active remote sensing); Optical remote sensing – Data acquisition: Sensors and systems; Microwave remote sensing – Principles, Microwave systems, Radar imaging, geometry of SAR.	10 hours
Pedagogy:	Lectures/assignments/workshops/ street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations.	
References/ Readings	1. Konecny G. Geoinformation: remote sensing, photogrammetry, geographic information systems. Taylor and Francis, London, 2003. 2. Campbell JB. Introduction to remote sensing, 4th edn. Guilford Press, New York. 2007 3. Burroughs WJ. Climate change: a multidisciplinary approach, 2nd edn. Cambridge University Press, Cambridge, 2007 4. Jensen JR (2005) Introductory digital image processing: a remote sensing perspective, 3rd edn. Prentice-Hall, NJ 5. Longley PA, Goodchild MF, Maguire DJ, Rhind DW. Geographic information systems and science. Wiley, West Sussex, England, 2005 6. Anjireddy, M. Textbook of Remote Sensing and GIS. BS Publications, 453p, 2008. 7. Gabor Farkas. Practical GIS. Packts Publishing, 402p. 2017. 8. Joel Lawhead. Learning Geospatial Analysis with Python. Packts Publishing, BIRMINGHAM – MUMBAI. 433p. Third Edition. 2019. 9. Reza, H P and Candan G. Spatial Modeling in GIS and R for Earth and Environmental Sciences, 770p. Elsevier, 2019.	
Learning Outcomes	Successful completion of the course, the students will be prepared to demonstrate: 1. Self-knowledge of their individual strengths and weaknesses in understanding the geospatial applications for environmental management. 2. Lifelong learning skills in Geospatial Technologies.	

Title of the Course: Basic Statistics
Course Code: ESC-204 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

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 5: 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.	4 hours 6 hours 16 hours 10 hours
Pedagogy:	Lectures/assignments/workshops/ street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations.	
References/Readings	1. *Statistics for Managers: Using Microsoft Excel*, by David M. Levine, David F. Stephan, Timothy C. Krehbiel, and Mark L. Berenson, Pearson Education, Inc., (2008) Fifth Edition or later. 2. *Statistics*, by Robert S. Witte and John S. Witte, Wiley, Eleventh Edition, (2017). 3. *Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R* by Christian Heumann, Michael Schomaker, and Shalabh , Springer, (2016) 4. *Statistics for Business and Economics*, by James T. McClave, P. George Benson, Terry Sincich, Perason, (2018).	
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-205 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2021-22

Prerequisites for the course:	Completion of first semester of the programme
Objectives:	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.	6 hours 6 hours 12 hours 12 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. V. Murali Krishna and Valli Manickam, Environmental Management, Butterworth-Heinemann, 2017 2. Vijay Kulkarni and T V Ramchandra, Environmental Management, Commonwealth of Learning, Indian Institute of Science, 2009	
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-206 **Number of Credits:** 01
Total Contact Hours: 12 **Effective from AY:** 2021-22

Prerequisites for the course:	Completion of first semester of the prgramme	
Objectives:	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.	12 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. Anjaneyulu Yerramilli and Valli Manickam. Environmental Impact Assessment Methodologies (3rd edition), 2020. BS Publications / BSP Books. 2. John Glasson and Riki Therivel. Introduction to Environmental Impact Assessment (5th Edition), 2019. Routledge. 3. Khandeshwar, S.R., N.S. Raman and A.R. Gajbhiye. Environmental Impact Assessment. 2019. Dreamtech Press. EIA manuals available at: 1. http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel3.html 2. Sectoral Manuals under EIA Notification, 2006: http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel2.html 3. Anonymous. Environmental Impact Assessment Training Manual. 2016. International Institute for Sustainable Development. http://www.iisd.org/learning/eia/wp-content/uploads/2016/06/EIA-Manual.pdf 4. 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.	

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Annexure II

Ordinance relating to MSc/M.A Environmental Science, Two year Multidisciplinary programme

OB.XX.1 Objective

The programme will provide a broad-based education to students who wish to explore multidisciplinary approaches to scientific enquiry to enable them to acquire skill sets which could make them employable.

OB.XX.2Degree Awarded

On completion of the two year programme, successful candidates will be awarded M.Sc./M.A (Environmental Science) Degree.

Intake to each specialisationshall be based on GUART ranking and fulfilment of each specialization's course requirements.

OB.XX.3Eligibility & Admission

i) Eligibility for M.Sc. (Environmental Science) programme would be a pass in B.Sc/B.Tech/M.B.B.S degree (or equivalent).

ii) Eligibility for M.A. (Environmental Science) programme would be a pass in B.A./B.Com/B.Sc/B.Tech/MBBS/LLB (or equivalent).

Though the intake of students for both the programmes M.A/M.Sc Environmental Science together shall be as per the common ordinance existing for PG programmesof the University,since PG programmes in Environmental science have been envisaged as online, after successful completion of one batch of students, the intake will vary accordingly. Admission will be based on the merit list prepared separately for M.A and M.Sc in Environmental Science on the basis of GUART among eligible candidates and as per guidelines of University.

OB.XX.4Programme Structure

i) Programme will consist of 2 academic years (4 semesters) where degrees of M.Sc. (Environmental Science)/ MA (Environmental Science) shall be awarded subject to the candidate acquiring minimum prescribed credits. To get the degree in M.ScEnviromentalSceince, students have to earn minimum of 48 credits in science courses out of 64 credits.

ii) The Programme shall be based on a system of time-integrated units called credits, under the Choice Based Credit System (CBCS) and shall comprise core courses, domain and optional courses and Dissertation/Internship/Project (compulsory)

iii) The Courses cover only theory, theory and tutorial/practical, or any other activity as specified by the BoS.

iv) Optional Courses may also comprise self-learning Courses in the form of field work, project, summer training, online Courses, and other such Courses; the BoS shall specify the Credits for these activities.

v) A student shall also be permitted to obtain additional Credits. The degree/final grade shall be awarded /computed based on his/her performance in Core Courses and the best performance in the Optional Courses, to fulfill the minimum number of Credits required for

the award of the Master's Degree. Additional Credits, if any, shall be depicted in the final transcript/mark sheet.

vi) A Course may be a minimum of 1 Credit and up to a maximum of Credit(s).

vii) One Credit of a Theory Course shall be equivalent to 12 contact hours of learning activities including lecture, group discussion, seminar, problem solving, tutorial, assessment and such others.

viii) One Credit of a Practical Course shall be equivalent to 24 clock hours of laboratory /field work/ study tour, that is, 12 practical sessions each of 2 clock hours duration, or its equivalent.

ix) The students shall be notified of the Core and optional Courses offered for a forthcoming Semester.

x) Minimum number of students for an Optional Course shall be not less than five. In case there are less than five students for a Course, the permission of the Vice-Chancellor shall be obtained before the commencement of teaching for the said Course.

xi) Project/Dissertation shall be a minimum of 8 Credits and in lieu of optional courses. However, in disciplines where a project is a mandatory requirement, the Project/Dissertation shall be a minimum of 12 credits in the final semester of the degree program.

xii) A student shall not be permitted to register for less than 12 Credits and more than 26 credits in each semester during the programme.

xiii) Core Course offered by a Department/School may be selected by a student as an optinalcourse provided the pre-requisites defined by the concerned Board of Studies are fulfilled by the student.

Semester wise courses and credits MSc / M.A. (Environmental Science): Tabular presentation
Semester - 1

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
1	ESC-101	Environmental issues and perspectives	3	Sociology	SEOAS
2	ESC-102	Fundamentals of economics	3	GBS (EC)	
3	ESC-103	Environmental ethics	3	Philosophy	
4	ESC-104	Ecosystems and biodiversity	3	Botany	
5	ESC-105	Land, ocean and atmospheric interactions	3	SEOAS	
6	ESC-106	Environmental impact assessment I	1	Zoology	
		Semester I Total Credits	**16**		

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Semester - II

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-201	Ecology and society	3	Zoology	MPS, Sociology
8	ESC-202	Climate change and sustainability	3	SEOAS	Zoology, Botany, GBS
9	ESC-203	Geoinformatics	3	SEOAS	
10	ESC-204	Statistics	3	GSB	
11	ESC-205	Environmental management	3	GBS	
12	ESC-206	Environmental impact assessment II	1	Botany	
		Semester II Total Credits	**16**		

Semester - III

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-301	Environmental Impact Assessment - III	3	SEOAS	
8	ESO-302	Optional Course - 1	3		
9	ESO-303	Optional Course - 2	3		
10	ESO-304	Optional Course - 3	3		
11	ESO-305	Optional Course - 4	2		
12	ESO-306	Optional Course - 5	2		
		Semester III Total Credits	**16**		

Semester - IV

Sr. no.	Course code	Course title	No. of credits	Lead School/ Depts.	Collaborating Depts.
7	ESC-401	Environmental Impact Assessment IV	3	SEOAS	
8	ESO-402	Optional - 6	3		
9	ESO-403	Optional - 7	2		
10	ESO-409	EIA Dissertation	8		
		Semester IV Total Credits	**16**		
		Total Credits of the Programme	**16 + 16 + 16 + 16 =64**		

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