Dnyanprassarak Mandal's

College and Research Centre

ASSAGAO - BARDEZ, GOA (ACCREDITED BY NAAC WITH A GRADE)

Class : M.Sc. Environmental Science

Semester : I Academic Year : 2021-22

Programme - Core Courses

Sr. no.	Course code	Course title	No. of credits
1	ESC-101	Environmental issues and perspectives	3
2	ESC-102	Fundamentals of economics	3
3	ESC-103	Environmental ethics	3
4	ESC-104	Ecosystems and biodiversity	3
5	ESC-105	Land, ocean and atmospheric interactions	3
6	ESC-106	Environmental impact assessment I	1

Mini projects / Research paper Analysis / Field visits and Internships / Skill Based Certificate Courses are part of the Curriculum

Detailed Syllabus

M.Sc. Environmental Science

Title of the Course: Environmental Issues and Perspectives

Course Code: ESC-101 Total Contact Hours: 36

Number of Credits: 03 Effective from AY: 2021-22

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Prerequisites for	There is no prerequisite for this course apart from the program			
the course:	requirements			
Objective:	This course is an invitation to the study of environment in its multiple			
	nuances. While familiarising environmental issues all the course a	also intends		
	to introduce students to perspectives on environment.			
Content:	Module 1: Introduction to Environment	10 hours		
	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			
	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 o	discussion/ presentations	
References/Readi ngs	1.	Basu, Mahua and Xavier S. 2016. Fundamentals of Environmental Studies. New Delhi: Cambridge University Press.	
	2.	Carolyn, Merchant (Ed.). 1996. <i>Ecology</i> . 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. <i>Ecology and Equity</i> . 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.). <i>Environmental issues in India: A Reader.</i> India: Dorling Kindersley.	
Learning	1.	Students are introduced to the multi-dimensional feature of environmental reality.	
oucomes	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

Prerequisites	There is no prerequisite for this course apart from the program	
for the	requirements	
Course:	The sim of the course is to introduce students to the basic cones	ntc
Objective:	theories and principles that will provide the foundation for a pro understanding of how an economy works. The syllabus seeks to e students with the basic tools necessary for an understanding and interpretation of economic issues affecting the economy.	per equip
Content:	Module 1: Introduction	04
	Scope and method of economics; Building blocks of modern economy – agents, resources and classification of goods.	hours
	Module 2: Microeconomic analysis	
	Consumer equilibrium, producer equilibrium, market equilibrium, general equilibrium and possible disequilibrium situations.	10 hours
	Module 3: Macroeconomic analysis Circular flow and national income, issues related to growth, unemployment and inflation.	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/R eadings	 Dasgupta, Partha (2007) Economics: A Very Short Introduction; (2007), Oxford Mankiw, G., (2018). Principles of Economics, 8th Edition, Boston: Cengage Learning. Samuelson, Paul A. & William D. Nordhaus (2019) Economics, McGraw Hill Duflo, Esther & Abhijit Banerjee (2019) Good Economics for Hard Times : Better Answers to Our Biggest Problems, Hachette Books 	
Learning	1. The students will be able to understand the basic concepts-	principles
outcomes	and theories of Economics. 2. This course will enable the students to understand and different types of equilibrium, circular flow of the economy ar	analyse

affecting	g growth a	nd en	nploym	ent ir	n an eco	non	ny.		
3. The	students	will	learn	the	basics	of	international	trade	and
fundame	ental conce	epts i	n publi	c eco	nomics.				

Title of the Course: Environmental Ethics

Course Code: ESC-103

Number of Credits: 03

Total Contact Hours: 36

Prerequisites for the course:	There is no prerequisite for this course apart from the pro- requirements	gramme
Objectives:	 To analyse different approaches and broad the environmental philosophy. Understand the philosophical basis of various contended the philosophical basis of various contended. 	neories of onservative
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/Readin gs	 John Passmore, Man's Responsibility for Nature, New York: Charles Scribner's son, 1974. Robin Attfield, Environmental Philosophy, Cambridge: Polity Press, 2014. Paul W. Taylor, Respect for Nature: A Theory of Environmental Ethics, Princeton, Princeton University Press, 1986. John. A. Grim (edt.), Indigenous Traditions and Ecology- The Inter-being of Cosmology and Community, Harvard University Press, 2001. Dale Jamieson, Ethics and Environment- An Introduction, New York, Cambridge University Press, 2008. 	

	 Ronald Sandler, Environmental Ethics: Theory in Practice, USA, Oxford University Press, 2017. 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. Francois Jaquet, "Is Speciesism Wrong by Definition?", Journal of Agricultural and Environmental Ethics volume 32, (3), 2019. 	
Learning Outcomes	 Students will be able to learn and evaluate different theories of environmental ethics. 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

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Prerequisite for the course:	There is no prerequisite for this course apart from the program requiren	nents
Course objectives:	The course provides the fundamentals about ecosystems, their distribution, components, functioning, services and their role in biodive Biotic components of ecosystems, fundamentally understood as Biodive their measure, and factors that lead to enormous biodiversity, and ese components that maintain biodiversity. More importantly, knowledge or resilience and thresholds, which are required for management conservation of both biodiversity and ecosystems will be imparted.	types, versity. versity, sential n their t and
Content:	Module 1: Introdcution 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	9 hours

	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.	9 hours
	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.	6 hours
	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.	6 hours
	Module 5: Biodiversity of India	G
	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.	o hours
Pedagogy:	Lectures/assignments/workshops/campus walks/documentaries and discussion/ presentations.	
References/ Readings	 Chapman, J. L. & M. J. Reiss (1999). Ecology: Principles and Applications, Second edition. Cambridge University Press. ISBN: 0521588022, 9780521588027 	
	 Kormondy, Edward J. (2017) Concepts of Ecology, 4th Edition. Pearson. ISBN-10: 9332586098; ISBN-13: 978-9332586093 	
	 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
g	 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
1	10. Henderson, Peter A. & T. R. E. Southwood (2016), Ecological Methods, 4th edition. John Wiley & Sons. ISBN:1118895282, 9781118895283
1	 Jørgensen, S., L. Xu & R. Costanza (2016). Handbook of Ecological Indicators for Assessment of Ecosystem Health, Second edition. CRC Press. ISBN: 1439809372, 9781439809372
1	 Jorgensen, Sven Erik (Ed.) (2009) Ecosystem Ecology. Elsevier. ISBN: 0444534660, 9780444534668
1	 Krebs, Charles J. (2013). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition. Pearson. ISBN: 1292026278, 9781292026275
1	 Raffaelli, David G. & Christopher L. J. Frid (Eds.) (2010). Ecosystem Ecology: A New Synthesis. Cambridge University Press. ISBN: 1139486144, 9781139486149
1	 Smith, T.M. & R.L. Smith (). Elements of Ecology, Ninth Edition. Person. ISBN: 1292077409, 9781292077406
1	 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.	
	 Able to see the connectivity among all the components of ecosystems and their services. 	
	 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.	

Title of the Course: Land, Ocean and Atmospheric interactions

Course Code: ESC-105

Number of Credits: 03

Total Contact Hours: 36

Prerequisites for the course:	There is no prerequisite for this course apart from the program requi	rements
Objective:	The course will impart an insight to the students about the need for a approach to study an ecosystem.	an integral
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.
Pedagogy:	Use of conventional, online and ICT Methods. Lecture/Tutorials/Assignments
References/ Readings	 Wallace, J. M., and P. V. Hobbs, Atmospheric Science: An Introductory Survey, 2nd edition, Elsevier Academic Press, 2006.
	 Marshall J., and R. A. Plumb, Atmosphere Ocean and Climate Dynamics: An Introductory Text, Elsevier Academic Press, 2008.
	 Hess, L. S., Introduction to Theoretical Meteorology, Wiley Online Library.
	 Houghton, J. T., Physics of the Atmosphere, Cambridge University Press, 2002.
	5. Stewart, R. L., Introduction to Physical Oceanography.
	 Waves, Tides and Shallow Water Processes: Open University Course Team and Butterworth- Heinemann Publications, Oxford, UK, 1999.
	 Williams, F. J., and S. Elder, Fluid Physics for Oceanographers and Physics: An introduction to incompressible, US Naval Academy, Paragon Press.
	 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.
	 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.
	 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.	
	 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.	

Title of the Course: Environmental Impact Assessment - I

Course Code:	ESC-106
Total Contact	Hours: 12

Number of Credits: 01 Effective from AY: 2021-22

Prerequisites for the	There is no prerequisite for this course apart from the programme		
course:	requirements		
Objective:	n order to overcome the problems of environmental degradation, it is very		
	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 12 hours 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. 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	 Glasson, J., Therivl. R & Chadwick, A. (2005). Introduction to Environmental Impact Assessment. Published by Routledge. Taylor and Francis Group. New York Arts, J., & Morrison-Saunders, A. (Eds.). (2012). Assessing impact: handbook of EIA and SEA follow-up. Routledge. Taylor and Francis Group. New York Abaza, H., Bisset, R., Sadler, B., (2004). Environmental Impact Assessment and Strategic Environmental Assessment: towards an Integrated approach. UNEP. Therivel, R., & Wood, G. (Eds.). (2017). Methods of environmental and social impact assessment. Routledge.Taylor and Francis Group. New York. 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. 	